POSTURING FIELD SERVICE TO MEET THE NEEDS OF 1985

ABOUT INPUT

THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries
depth research.
clients on importa
members analyze c
data, then develc
innovative ideas
Clients receive
access to data on
and continuous con

Many of INPUT's p
have nearly 20 y
areas of specializ
senior managemen
marketing, or pl
enables INPUT to
to complex busines

Formed in 1974,
leading internati
Clients include o
largest and mos
companies.

UNITED STATES, West Coast
2471 East Bayshore Road
Suite 600
Palo Alto, California 94303
(415) 493-1600
Telex 171407

4676 Admiralty Way
#401 C
Marina Del Rey, California 90291
(213) 823-1230

UNITED STATES, East Coast
o West-1
, New Jersey 07662
71

OM

4th Floor)

7-9 Merriwa Street
don N.S.W. 2072

uku
Tokyo
Japan 160
(03) 371-3082

POSTURING FIELD SERVICE TO MEET THE NEEDS OF 1985

Prepared For:

CALMA

SEPTEMBER 1980

POSTURING FIELD SERVICE TO MEET THE NEEDS OF 1985

TABLE OF CONTENTS

POSTURING FIELD SERVICE TO MEET THE NEEDS OF 1985

LIST OF EXHIBITS

1 INTRODUCTION

I INTRODUCTION

A. SCOPE AND PURPOSE

- The primary objective of this study was to determine the kind of field engineering organization required by CALMA in 1985 to respond effectively to the business demands at that time, and to posture the organization so that it is both profitable and more responsive than its competitors.

- The project was divided into two phases:

  - Phase I:

    . Examined CALMA's current organization, capabilities and weaknesses and performed a comparison to what users require of a CAD/CAM vendor.

    . Identified 1980-1985 product plans for key OEM suppliers to the industry.

    . Determined the corresponding effects of product plans upon field engineering requirements for the end user.

    . Developed a concept of available product service techniques and test equipment requirements in 1985.

. Developed an interim scenario for the 1985 CAD/CAM field engineering environment to be tested in Phase II.

- Phase II:

. Performed extensive competitor and user research to evaluate and test the scenario developed in Phase I.

. Revised and extended the scenario to include driving forces and challenges to CAD/CAM field engineering in the mid-1980s.

B. METHODOLOGY

- Phase I.

- Corporate executives and field engineering management were interviewed on-site at CALMA facilities. The purpose and findings of those interviews are discussed in detail in Chapter III, "CALMA Executive Interviews."

- OEM vendors who supply devices of the types expected to be used by CALMA were surveyed by telephone and by on-site interviews. The details of the findings from OEM vendor interviews are discussed in Chapter IV, "Vendor Analysis."

- Findings from the interviews were tabulated, analyzed and merged with ongoing research at INPUT to develop a scenario for 1985 field engineering in CAD/CAM.

. An oral presentation of the interim findings was conducted at CALMA at the end of Phase I.

. The interim findings are included, where appropriate, in the final report, the major portion being contained in Chapter II, "Executive Summary."

- Phase II.

  - Analyses of issues and driving forces affecting CAD/CAM field engineering through 1985 were performed in preparation for user and competitor interviews. Results of the analyses are discussed in Chapter II, "Executive Summary."

  - CALMA competitors and potential competitors were sampled and interviewed on-site. Chapter VI, "Competitor Analysis," is dedicated to a discussion of these interviews.

  - CALMA users were sampled and interviewed by telephone. Chapter V, "User Analysis," discusses the findings of the user survey.

  - All data and analyses from Phase I and Phase II were consolidated to revise the scenario for 1985 CAD/CAM field engineering and to form final conclusions and recommendations.

  - An oral presentation was prepared and delivered to CALMA field engineering management at the conclusion of Phase II.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. ISSUES AND DRIVING FORCES AFFECTING CALMA FIELD ENGINEERING, 1980-1985

- CALMA Field Engineering derives its business and purpose from the direction and efforts of the entire CALMA organization. Therefore the primary FE driving forces are to be found within the company.

  - Field Engineering is perceived as subordinate to, and supportive of, the total marketing effort at CALMA.

  - CALMA maintains a high priority on meeting production schedules responsive to heavy demand.

    . Emphasis on heavy production will continue through 1985.

    . Transition from a job-shop to a more standard systems configuration environment is underway, and will continue for at least two years. CALMA's success to date is based on its technical capabilities to respond to the demands and requirements of the CAD/CAM market.

    . Technical emphasis is likely to continue through 1982.

. Transition to an emphasis on creative marketing has begun, and should be evident by 1983.

- As a subsidiary of a large, well-funded company, CALMA is afforded opportunities to make capital investments and commitments to changes in the market for CAD/CAM. CALMA has access to:

  . Direct funds and credit.

  . Established data communications networks.

  . Data management and management information systems through a sister company.

- CALMA's growth rate creates excessive demands on management development.

  . Organizational structure will remain unstable for at least two years.

  . More new faces in key positions will be required to keep pace with projected growth.

  . Management By Objectives (MBO) programs will be constantly changing to conform to dynamic forces in a fast-growing company.

- The primary driving forces affecting CALMA originate in the CAD/CAM marketplace.

  - The CAD/CAM marketplace from 1980 through 1982 will be characterized by high demand and low supply.

. Vendor emphasis will be on meeting production and delivery schedules.

. Users will tend to be more forgiving of poor service relative to traditional data processing criteria.

- The CAD/CAM marketplace from 1983 on will be characterized by heavy competition from established computer vendors as well as from new entries in the turnkey business.

. User loyalties to existing suppliers will be based on the responsiveness that the service organizations demonstrate in the earlier years.

. User purchase decisions will be based less on availability and best delivery schedules than now.

. Purchase decisions will be made on the basis of price/performance, vendor track records in after-sale service and support, vendor track records in responsive product development, and referable accounts.

• Characteristics of CAD/CAM products represent a major driving force in proper planning for the CALMA Field Engineering management team.

- Standalone turnkey systems will dominate the CAD/CAM market at least through 1982.

. There will be a rapid build-up of multiple workstations controlled by a single minicomputer.

. Intelligent workstations hosted by 32-bit minicomputers will be required to meet response criteria.

- The CAD/CAM installed base will continue to be dominated by turnkey systems in the 1983-1985 timeframe, but installations of large in-house computers controlling CAD/CAM will be growing at a faster rate than turnkey systems.

  . INPUT estimates that, in electronics applications, sales of turnkey systems will grow at an average annual rate of approximately 50% through 1985, while sales in the in-house computer-hosted systems will approach a 70% average annual growth rate.

  . CAD/CAM product identification by the user community will shift away from unique hardware towards unique software.

  . Standalone products will become more and more specialized in applications.

  . Innovations will be necessary to the future development of turnkey systems if they are to remain dominant; for example:

    - Mass storage techniques for minicomputers.

    - Peripheral array processors for "number-crunching" assignments.

  . Color graphics will be commonplace in the 1983-1985 timeframe.

  . The state of the art in optical pattern recognition will be advanced.

  . It is expected that there will be a breakthrough in cost/performance in hologram technology to afford three-dimensional terminals for special applications.

. Workstations will become much "friendlier" to users, and consequently more complex to service.

- Voice menus and dialogue between operator and systems will be available.

- Less and less knowledge of programming and equipment will be required of users.

. Independent designer service bureaus will become more evident by 1983.

- Availability of qualified personnel will be a major problem in the 1980-1983 timeframe, easing up in the following years.

- The general data processing hardware business continues at an average annual growth rate (AAGR) of 15 percent, while available maintenance personnel are growing at 11 percent AAGR.

. The personnel availability problem in turnkey CAD/CAM field engineering is compounded by the fact that the industry expects higher-qualified people on-site.

. The problem is also compounded by the fact that CAD/CAM field engineering personnel requirements are growing at a significantly greater AAGR than are the requirements of the industry in general.

- CALMA's competitors in the turnkey maintenance function rated their competition as the number one source of personnel for the next five years, as shown in Exhibit II-1.

- Maintenance vendors are still reluctant to cross-train personnel in hardware and software.

EXHIBIT II-1

COMPETITOR RECRUITING SOURCES

SOURCES FOR FE PERSONNEL	RANKED PREFERENCE		
	1980	1983	1985
TRADE SCHOOLS	2.6	3.3	4.0
COMPETITION	3.8	4.0	4.3
ARMED FORCES	4.8	4.1	3.0
2-YEAR COLLEGE	1.3	2.0	2.7
4-YEAR COLLEGE	1.0	1.5	2.3
NO TRAINING	1.0	1.0	1.0

SCALE = 1-5, WHERE 1 = MINOR IMPORTANCE AND 5 = GREAT IMPORTANCE.
RESPONSES = 10

- A possible source of relief from the personnel shortage could be in the expected oversupply of software systems engineers over the next five years.

- New competitors entering the market will create a premium for "know-how" in all skills related to CAD/CAM; therefore CALMA will be vulnerable to more than one recruiting effort.

- Increased competition in the commercial training of general skills in computer maintenance should provide alternatives to in-company training at lower costs.

- Organized labor will make more overtures and efforts to organize field engineers during the 1980-1985 timeframe.

- Dramatic growth will cause CALMA to become more visible to government regulators in equal employment opportunity and affirmative action programs.

- Complete menus of employee fringe benefits will be offered by CALMA's competitors.

- Component expenses associated with maintenance versus affordable prices of maintenance contracts are expected to create a severe squeeze on profit margins unless some radical changes are implemented to improve the efficiency and utilization factors of field engineering.

  - Labor rates are increasing at a much higher rate than utilization (workload).

  - Transportation costs have doubled in the past 10 years, and are expected to increase at an even higher rate over the next five years.

- Carrying costs of spare parts inventories are expected to increase relative to units maintained.

  . Insurance premiums for greater value modules will be higher.

  . Property taxes will rise proportionate to the discrete value of inventories.

  . Storage costs will increase with real estate values.

- As the price/performance of hardware improves, the annual cost of maintenance approaches the users' barrier price, which is 15% of the purchase price, as shown in Exhibit II-2.

• CAD/CAM users will expect higher RAS (Reliability, Availability and Serviceability) in products and service in the eighties.

- Multiple workstations will create heavier demands in utilization of common system devices such as:

  . Mass storage devices.

  . Host CPU.

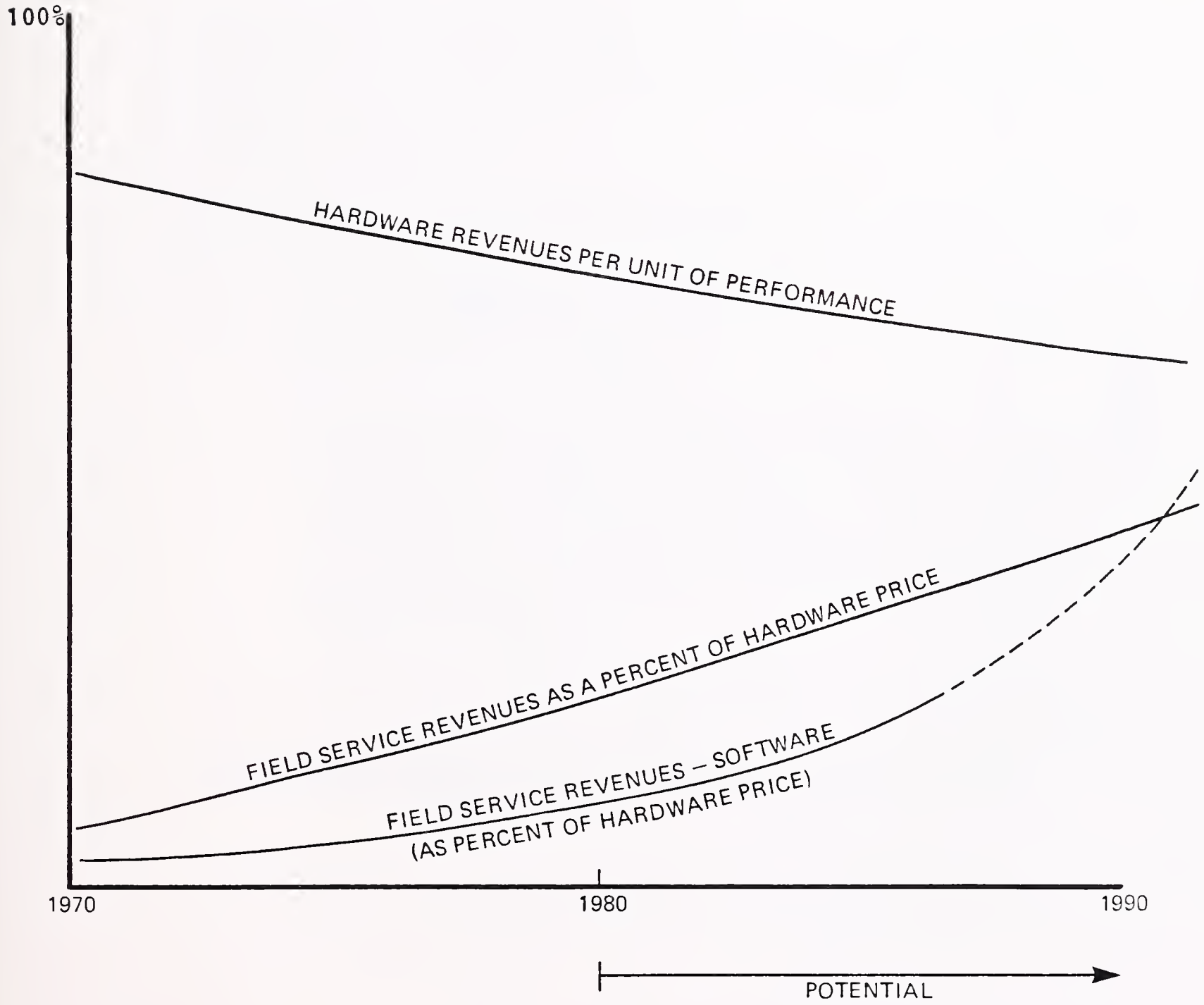
  . Pooled output devices.

- Users are anticipating that they will have single points of contact for the management of service in all cases of turnkey system failure.

- Users expect to see a 67% reduction in CAD/CAM system down time by 1985, as shown in Exhibit II-3.

EXHIBIT II-2

COMPARATIVE CHANGES IN HARDWARE PRICE/PERFORMANCE AND MAINTENANCE PRICE



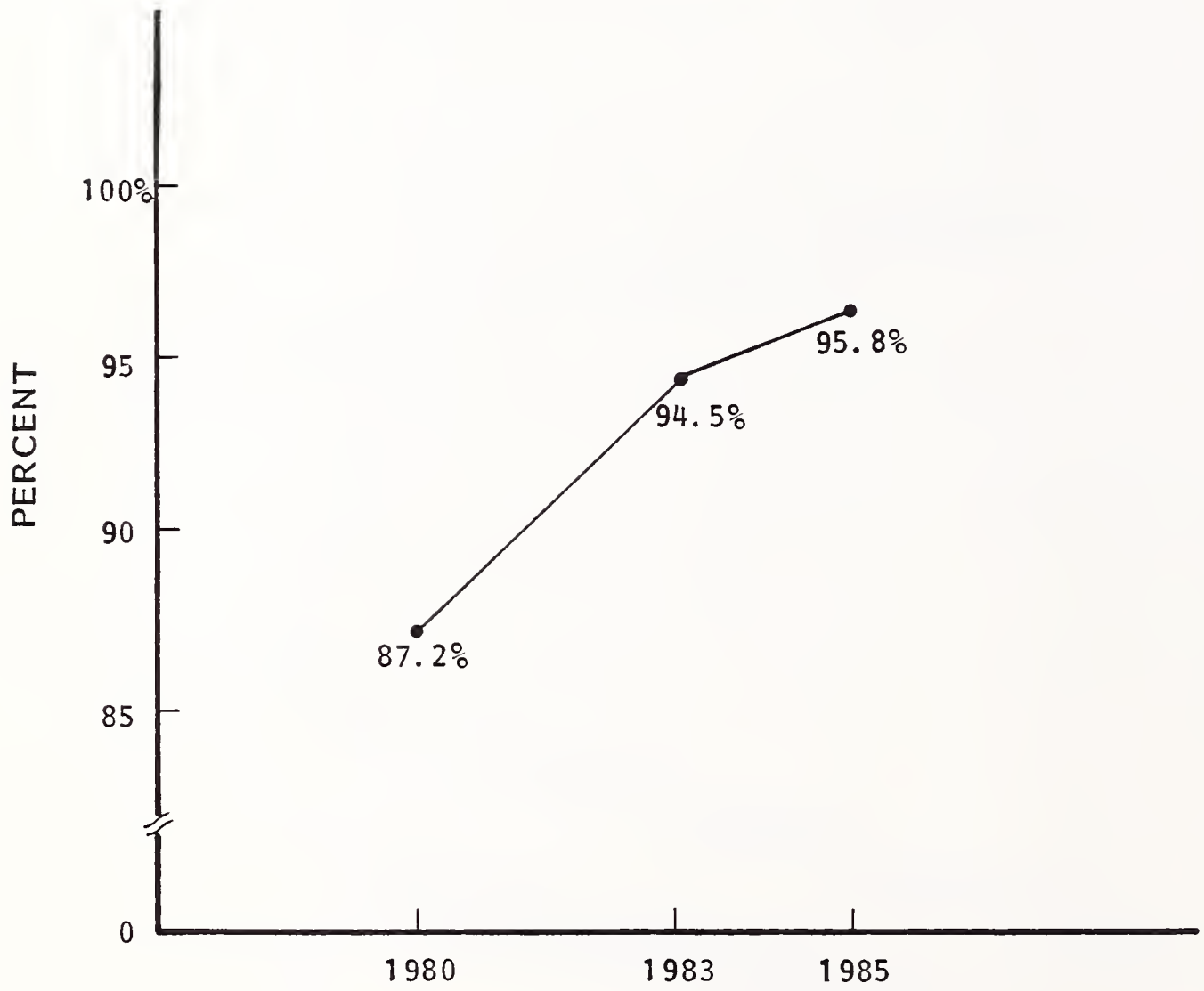
FIELD SERVICE HAS THE POTENTIAL TO BE THE DOMINANT REVENUE SOURCE IN THE LATE 1980s.

NOTE: THIS CHART IS CONCEPTUAL; IT IS NOT BASED ON SPECIFIC DATA

SOURCE: "1980 FIELD SERVICE ANNUAL REPORT"

EXHIBIT II-3

USERS'
PROJECTED TRENDS FOR
PERCENT UPTIME REQUIREMENTS,
1980-1985



. While users say they will accept 87.2% availability in present systems, they expect the availability to improve to 94.5% by 1983.

. Users were clear that their expectations of such dramatic improvements anticipated the changes in new equipment and configurations.

- CALMA users expect the Mean Time Between Failures (MTBF) of CAD/CAM systems to double by 1985, from 2.7 months to 5.5 months, as shown in Exhibit II-4.

. The increase in the users' acceptable level of reliability is even more dramatic when one considers the compounding effect of users increasing their workloads by a factor of 37%, as shown in Exhibit II-5.

. By calculating 21 days per month multiplied by the workload changes shown in Exhibit II-5, the nine hours per shift, and the months indicated in Exhibit II-4, the improvement in hours is expected to be from 970 hours MTBF to 2,700 hours MTBF for CAD/CAM systems.

- CALMA users who currently find 14.3 hours MTTR (Mean Time To Repair) acceptable expect the average to fall to 9.1 hours by 1985, as shown in Exhibit II-6.

- CALMA FEs will be more exposed to MIS directors as decision makers in CAD/CAM. MIS executives have years of experience in dealing with maintenance organizations.

- CALMA can expect to see a higher quality of competition in maintenance service as large, established mainframe vendors enter the market.

EXHIBIT II-4

PROJECTED TRENDS FOR
MTBF, 1980-1985

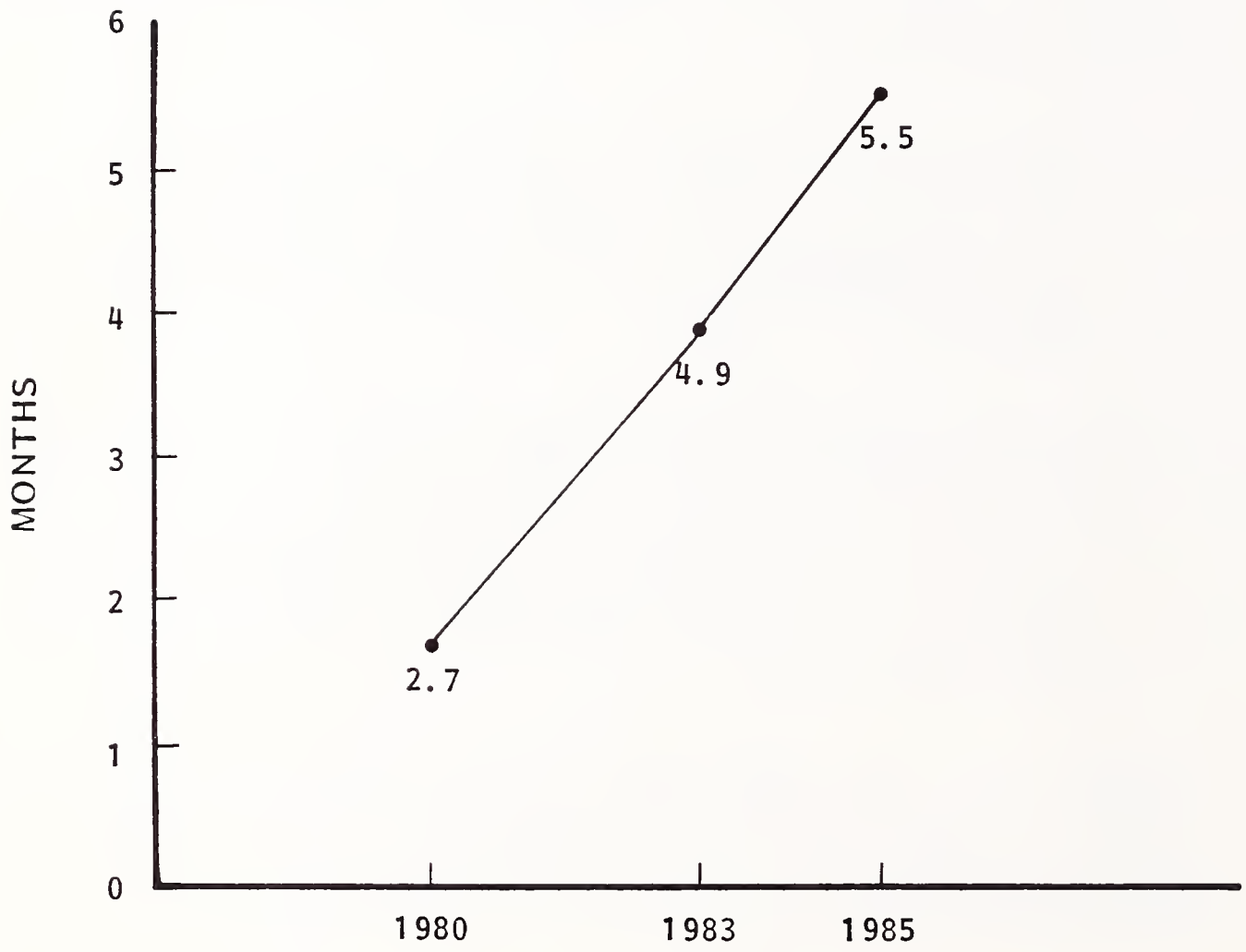


EXHIBIT II-5

USER
FORECASTED
WORKLOAD CHANGES,
1980-1985

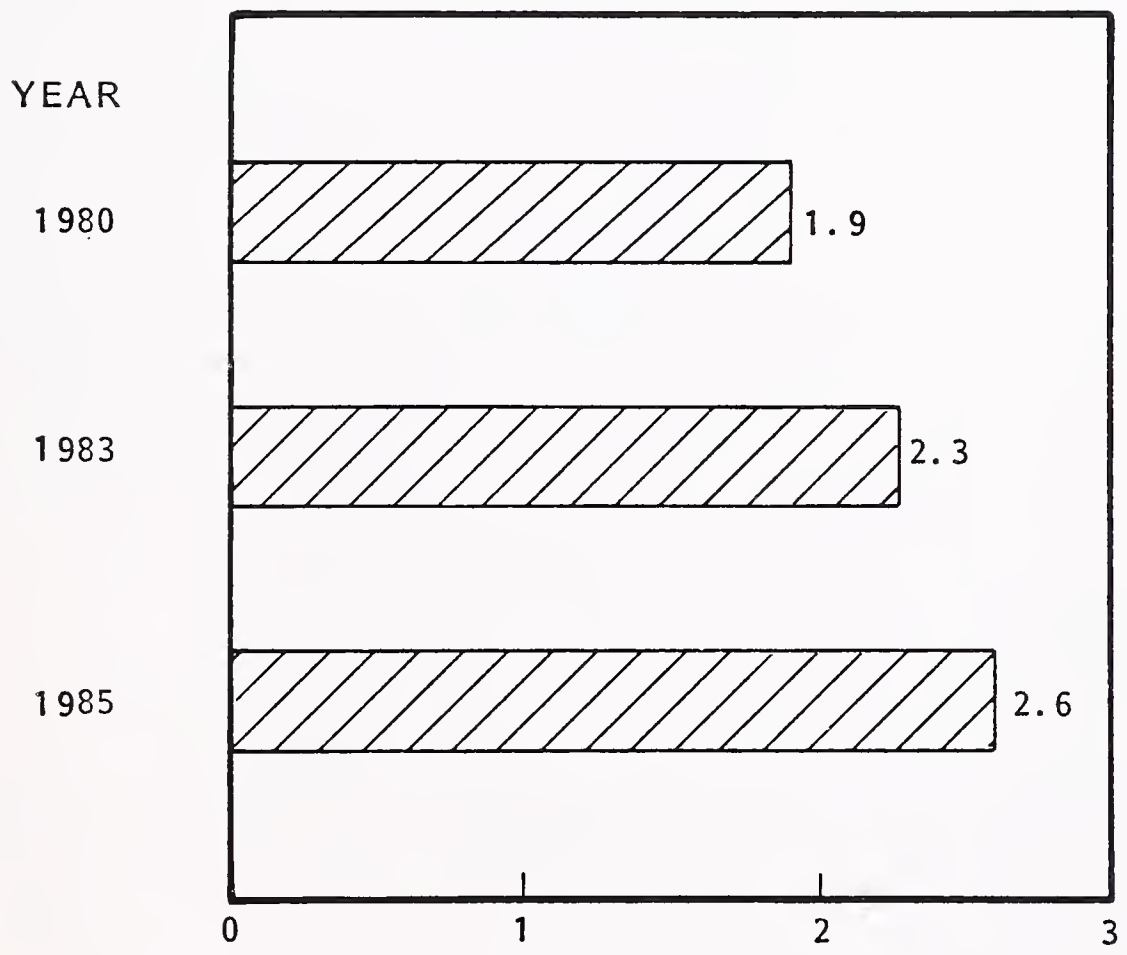
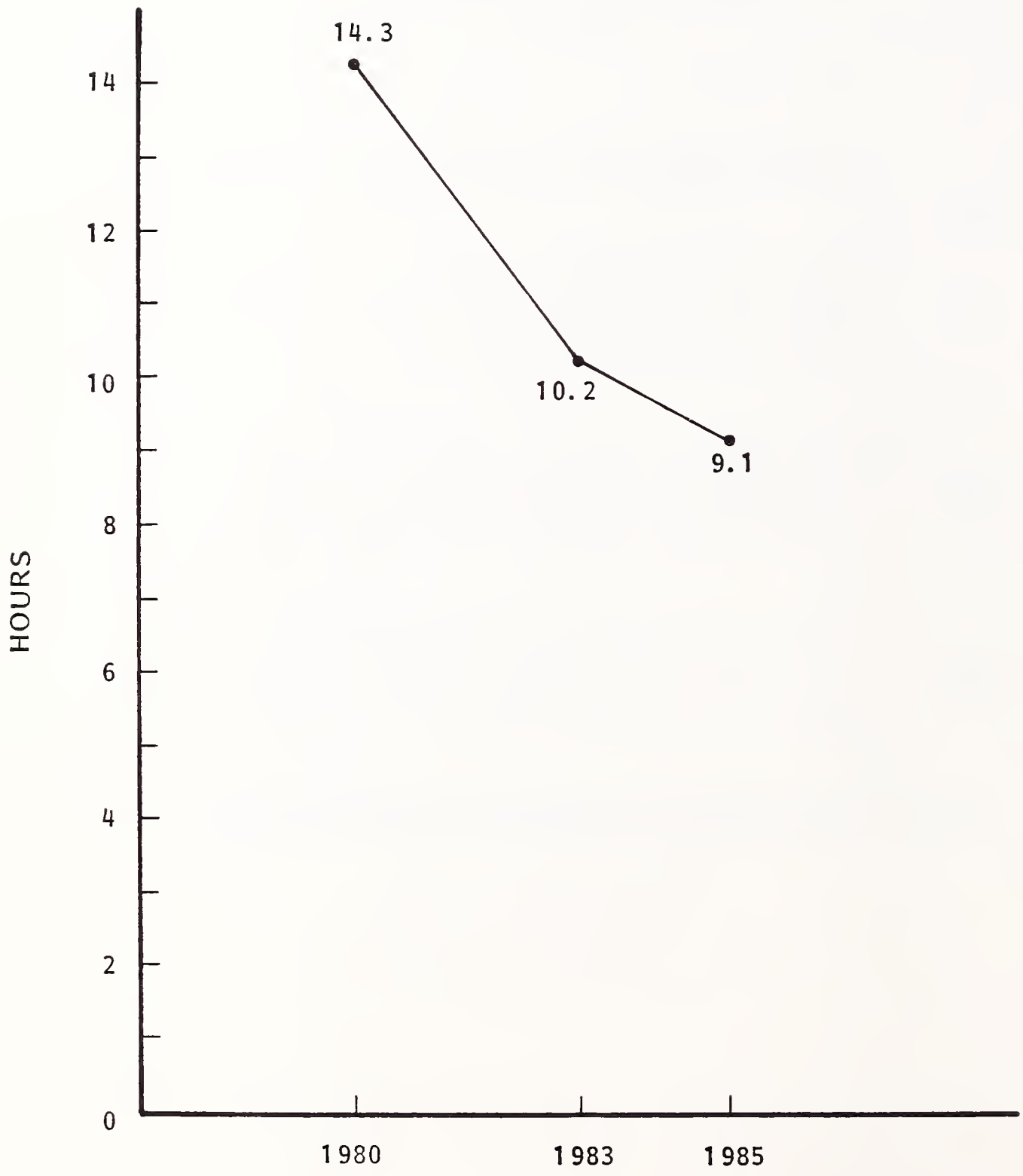


EXHIBIT II-6

PROJECTED TREND FOR
MTTRs, 1980-1985



- Two current turnkey competitors have more depth at key FE positions, and are better prepared than CALMA is to advance.

- Large vendors bring advantages with them, such as:

  . Credibility in general data processing maintenance.

  . Attractive career paths for recruiting personnel.

  . Large FE teams in place.

  . Established product geographic density with pricing advantages.

- Large vendors also bring in some disadvantages, such as:

  . Fewer "ground floor" opportunities.

  . Less flexibility and slower decision cycles.

  . More visibility to government regulatory agencies.

  . Need to develop specific experience in CAD/CAM.

- Experimentation by DP industry leaders in alternative methods of maintaining equipment is expected to continue through 1983. User acceptance of changes should become more apparent to CALMA in the 1982 time period.

  - "Unbundling" of maintenance contracts into separate pricing for the major components of maintenance is being tried with varying degrees of success.

  - FE divisions measured by profit margins and returns on invested capital have been in place since the early 1960s.

- Software maintenance by field engineers working for mainframe vendors became acceptable during the 1970s.

- Multitiered maintenance organizations have been in existence for over 10 years, but are slow to win user acceptance.

- System support centers in software and hardware are not new in concept, but are new in the present level of customer involvement with problem resolution.

- Repair depots for portable equipment are a relatively new experiment in the data processing industry.

- Remote diagnostics have been too expensive, relative to available personnel, until the proliferation of microprocessors.

- Separate FE departments within manufacturing companies are set up to operate strictly as third-party maintenance organizations.

B. FE MANAGEMENT CHALLENGES DERIVED FROM DRIVING FORCES, 1980-1985

- The most important challenge to FE management is to become more flexible and responsive to rapid changes in the CALMA internal environment.

  - In an industry growing as rapidly as CAD/CAM, tradition is less effective or important than progressive ideas and innovation.

  - FE managers should remain alert to shifts of emphasis and take their lead from tactical changes implemented by corporate executives.

- Communications channels from top to bottom must remain open in this dynamic environment to assure that all FE personnel are aware of changing conditions.

- As one of the key organizations within the marketplace, the FE department has several major challenges to meet in the next five years.

  - FE management has the opportunity to firmly establish a responsive image with users while demand is high for CAD/CAM products, a period in which CALMA's competitors might have a tendency to relax in the marketplace.

  - In order to meet the marketplace challenges beyond 1982, FE management should develop a high level of self-confidence in dealing with customer executives.

    . Managers can take advantage of good news and make certain that heroic efforts of their FEs are communicated directly to higher-level user executives.

    . FE managers should always have contingency plans during emergencies and be able to articulate their plans and decisions to customer executives. Nothing impresses a user more than the FE manager who assumes control in a visible, positive, non-defensive and nonapologetic manner.

  - CALMA FE managers should take the lead and exhibit noticeable pride in their association with CALMA products and service.

    . Search for positive statements in communications, no apologies for "growing pains," etc.

    . Respond to comments about competition in positive ways, for example, "They're good, but we're the best."

. FE managers should constantly remind themselves that FEs, for the most part, mirror the attitudes of their managers.

- Another marketplace challenge is to develop methods of justifying and communicating maintenance prices in relation to benefits provided.

- A fully market-oriented FE organization is most evident when the managers in headquarters staff functions display their primary concern for the maintenance and protection of the installed base of equipment.

- FE managers at CALMA have a special challenge over the next five years to remain involved in product development and to maintain a good level of knowledge about the total CAD/CAM product lines. They must:

  - Keep abreast of industry technological developments in software and hardware as they affect CAD/CAM.

  - Learn to communicate with users in terms of the "big picture" of their applications.

  - Persist in controlling the design of maintenance aids into products developed and purchased by CALMA.

  - Develop accurate data collection and information feedback systems vital to efficiencies in future development and production efforts.

  - Become more knowledgeable of larger host operating systems environments and telecommunications networks.

    . Understand mass storage and data management concepts and exposures.

    . Develop an overview of virtual systems and multiprocessors.

. Understand and appreciate the value of peripheral array processors in handling large volumes of double precision calculations.

- The importance of the challenges in personnel management cannot be overstated.

  - Develop good recruiting habits: recruiting is a full-time sales job.

  - Establish benefit programs and communications programs designed as aids in recruiting and retention of qualified personnel.

  - Identify promising candidates for promotion to higher responsibilities and establish customized development programs to accelerate their progress.

  - Strive for a reasonable balance of internal promotions with direct hiring for advanced positions.

  - Develop entry-level training programs to compensate for scarcity of available qualified personnel.

  - Improve affirmative action and equal employment programs.

  - Avoid unions by opening lines of communication with FEs at the first-line manager level.

  - Work to break down traditional obstacles to progress, such as:

    . Cross-training hardware and software.

    . Employment of women in service.

    . False notions about nepotism.

- Field support is the primary reason for the existence of most FE staff personnel and management at headquarters. The challenges are significant over the 1980-1985 timeframe at headquarters.

  - Develop and maintain a closed-loop escalation system with checks and balances to assure that contingency plans are in place for all extended outages.

    . Assure that staff communications with site FE's are supportive rather than punitive because of the extended outage.

    . Assure that users are aware that higher management is (not was) involved after certain checkpoints.

    . Assure that account sales persons are made aware of situations which may affect CALMA's image in the marketplace, and solicit assistance from sales in defusing emotional situations.

    . Assure that constructive analysis is performed on historical accounts of critical situations to minimize errors in the future.

    . Develop a sense of urgency in all headquarters personnel for any extended outage of a CALMA system, and for any outage resulting from a lack of proper resources to affect a repair.

  - Develop a solid working relationship with all CALMA OEM vendor support personnel.

    . Personal relationships cut through red tape.

    . FE management should not rely on third parties to expedite support from vendors.

- Develop modular advanced training programs to optimize training requirements.

  . Match individual needs for specific configurations.

  . Set up programmed packages for advanced individuals to learn at their own pace.

- Establish a technical information exchange and distribution system among all technical personnel, including FE, production, development and vendors.

- Feedback summary and conclusions based on data collection to encourage more timely and accurate reporting.

- Establish a smooth logistics support system consistent with changes in cost variables.

- Assure quick turnaround on personal expenses.

- Finally, in the 1980-1985 timeframe, CALMA FE management has the ultimate challenge to stand up and be counted among the business executives in the industry.

  - To a business manager, structure of the organization is always subordinate to business objectives and to the qualifications of people to accomplish the objectives through acceptance of responsibility.

    . A true businessperson will change the structure of the organization to maximize the effect of the best people available to the enterprise.

  - . Structures are not used by a businessperson as enhancements to self-images or excuses for not taking advantage of opportunities or meeting company commitments.

- A business manager expects to work with policies and procedures as guidelines to mature management judgement in making decisions.

- A businessperson will attempt to place CALMA's best interests ahead of FE department interests or personal interests.

- A business manager expects to be measured on individual contributions to CALMA's overall growth and profitability.

- Faced with conflict, a businessperson will attempt to negotiate a mutually beneficial solution, rather than debate in a winner-take-all atmosphere.

- A business manager will go for the best price available and lowest cost manageable, but ultimately recognizes that the price must be justified by the current value of the benefits provided.

- Business managers seek to maximize returns on invested capital in the intermediate term.

  - . A businessperson understands the need for deeper cost/benefit analysis in capital expenditure decisions.

  - . Capital expense analysis is a study in deferral of short-term benefits to the future of the business.

- A business manager will risk being wrong when a quick decision is clearly needed.

- A businessperson does not accept traditional levels of productivity and efficiency.

  . Question the workload assignments.

  . Question the approach to service as long as utilization is below 100%.

- A business manager will promote the best-qualified person for the job.

- Business managers act more than they react.

C. ALTERNATIVE ORGANIZATIONAL STRUCTURES FOR CALMA MAINTENANCE SERVICES

- A primary requirement for the organization of field service is that it is centralized at the top level of field service decision making.

  - CALMA does not have sufficient density of products to organize service along product lines.

  - Diseconomies are inherent in all traditional approaches to hardware maintenance, even in much larger organizations.

  - Priorities and conflicting demands on resources must be resolved at the lowest possible level qualified to retain objectivity (indifference) over the conflict of priorities.

- Another major requirement of the field service organization is that it reflect a functionally subordinate role to CALMA's overall marketing strategy.

- The organizational structure must provide a good liaison between service and sales at all levels in the field as well as at headquarter locations.

- The organization must be supportive to the sales effort in addition to its primary function of installing and protecting the installed base of equipment.

- A third major objective of the service organization structure must provide for technical communications, training, support and supervision by persons who understand the field service function from experience.

- Finally, the structure of the organization must reflect management's recognition of the fact that CALMA's product is a package of hardware and software.

- Exhibit II-7 displays the proposed structure for CALMA's field service organization to be postured for the challenges in the following years.

  - The vice president of field service would have total responsibility for servicing the turnkey products sold by CALMA.

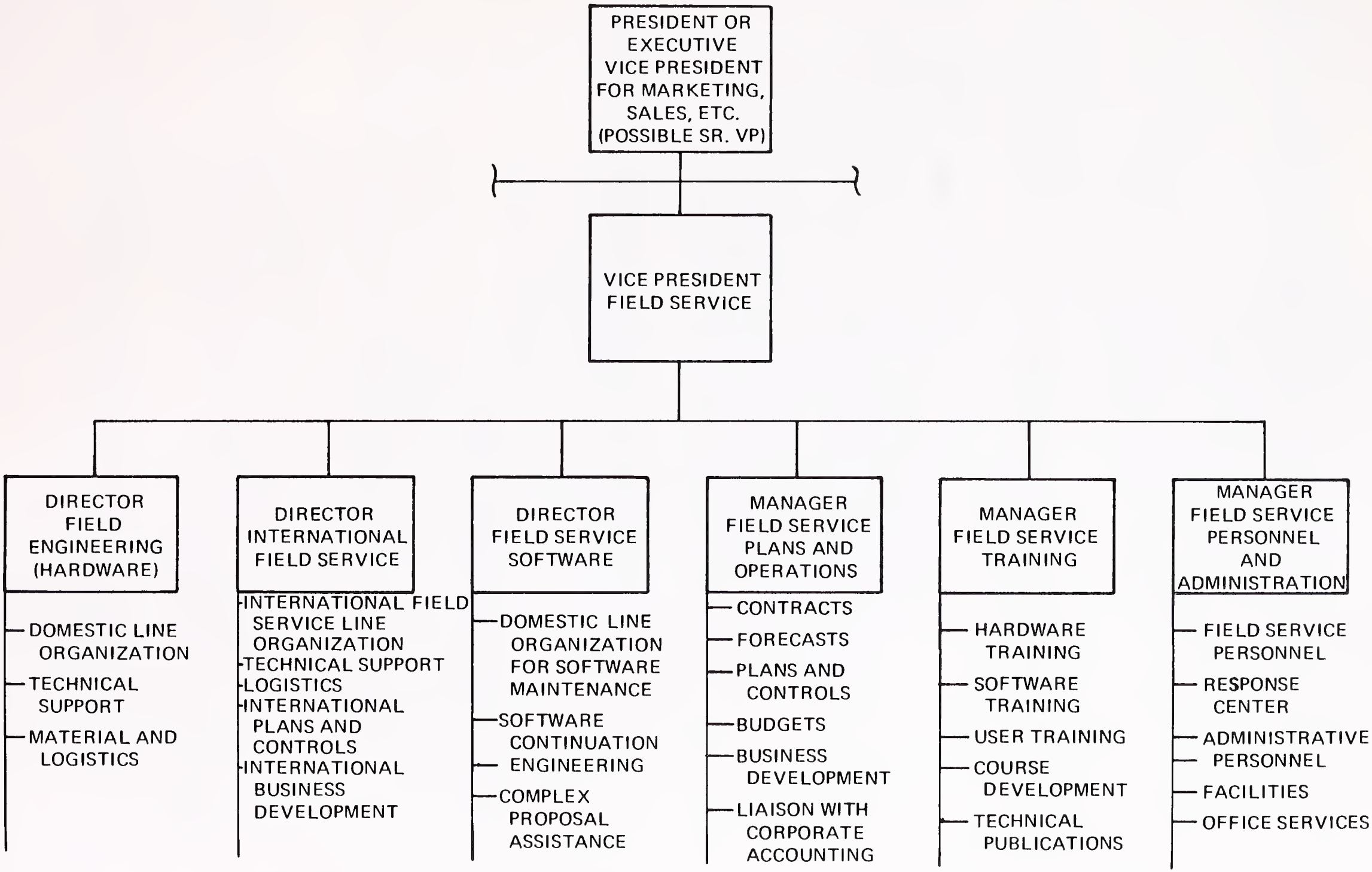
    . The vice president of field service should have depth of experience in the management of both hardware and software support groups.

- The field service department would report to a central executive, either the president or an executive vice president who also has responsibility for marketing and selling all of CALMA's products.

  - The three primary functions of international field service, domestic hardware service and domestic software service would be balanced under directors.

EXHIBIT II-7

PROPOSED FIELD SERVICE STRUCTURE



- The international service organization would be structured as a single source of service support having strong liaison with domestic functional managers.

- Backup support to international field service would be the responsibility of the two domestic directors.

- The three other staff functions would be centralized within the field service department.

  - Operations and planning would handle general department business in contracts, forecasting, business planning, budgeting and coordinating all accounting functions within the department.

  - Field service personnel and administration would manage the response center, all administrative personnel, facilities and the personnel function for the department.

  - Training would be centralized and would also be responsible for developing courses and managing technical publications.

D. OTHER RECOMMENDATIONS

- Accelerate personnel hiring program to lead workload projections by three to six months.

  - Index the personnel planning base to actual workload including anticipated per-call revenue and conversions of per-call to contracted maintenance.

  - Identify a dedicated resource to concentrate on recruiting service personnel.

  - . Hire a staff specialist with a good track record recruiting field service personnel.

  - . If a personnel search firm is used, negotiate an exclusive arrangement until the qualified personnel base reaches a more comfortable and stable level.

- Plan attrition for those who do not measure up to CALMA standards after reasonable efforts by management to upgrade their skills.

- Concentrate on spare parts planning and control.

  - The materials and logistics function should report to the highest management level responsible for hardware service (director of field engineering in proposed structure, as shown in Exhibit II-7).

  - Provide materials manager with complete cost data for logistics algorithms.

  - Develop direct purchasing power for field service materials planning.

  - Negotiate firm deadlines; e.g., six-month material forecasts and three-month firm orders.

  - Establish accountability for perpetual inventories at the field engineer's level.

    - . Start program with a standard cost method to control accountability.

    - . Force reconciliation of physical inventories to the lowest possible level.

  - Identify all stock locations by number.

- Overstock best usage estimates of high mortality parts at the district level.

  . Current sales forecasts justify increased investment in spares.

  . Redistribute stock as data collection methods become more accurate, providing necessary statistical information to calculate economic order quantities (EOQ) and optimum safety stock levels for each line item.

- Establish priorities for spare parts within the company.

  . Site-down is top priority.

  . Production schedule slippage creates a very close second priority to site-down.

  . Safety stock levels for production schedules and field service stock tied for third priority.

  . The lowest priority should be for retail sales of parts to outside purchasers.

- Establish a suspense system for the return of reparable parts after a report of equipment failure requiring parts replacement.

- Create a universal parts transfer document for control.

- Create special mobile stock location numbers for installation and burn-in kits and for unit/device parts caddies.

• Align financial accountability of the field service department with the FE mission, and balance profitability measurements with operational measurements of FE management.

- Schedule the implementation of a total profitability measurement system for the field engineering department next fiscal year.

- Break down the operating statement to the director level as soon as the accounting system will allow.

- Credit field service with all appropriate revenues and transfers of funds consistent with the services provided, such as:

  . Maintenance agreement (MA) revenue.

  . Installation charges (fixed fee or T&M (time & material)).

  . Warranty revenue (MA equivalent or T&M from production).

  . CALMA internal sites (MA equivalent or T&M).

  . Special projects (internal transfer rates).

  . Sales of any field service labor or assets.

- Debit the FE department with related expenses, such as:

  . Direct expenses.

  . Carrying charges on spares.

  . G&A allocation for central services.

  . Internal transfers for services from other departments not covered by G&A.

  . Depreciation and interest on assets.

  - . Occupancy charges for facilities.

  - . Reserves for parts shortages and direct charges for inventory variances in excess of reserve accounts.

- Establish operational measurements of the performance of field engineering, such as:

  - . Sales references gained or lost due to the service image.

  - . Changes in user attitudes measured by objective survey methods.

  - . Changes in response statistics.

  - . Changes in repair times and systems availability.

  - . Changes in personnel utilization factors.

  - . Extended warranties due to poor service.

  - . Percentage of repair calls reaching critical levels.

  - . Percentage of repeat calls.

  - . Average age of uninstalled engineering changes.

  - . Ratio of preventive maintenance hours to remedial maintenance hours.

  - . Personnel turnover.

  - . Ratio of customer executive visits to number of installed accounts.

- Percentage of users on maintenance contract.
- Spare parts usage and back orders.
- On-time reports versus average age of late reports.

III CALMA EXECUTIVE INTERVIEWS

III CALMA EXECUTIVE INTERVIEWS

A. SCOPE AND PURPOSE

- Through the interviews with key executives of CALMA and its field engineering management shown in Exhibit III-1, the following priorities were established for this study:

  - Evaluate the environment in which field engineering management must perform its role.

  - Assess the expectations of field engineering services as held by other corporate executives.

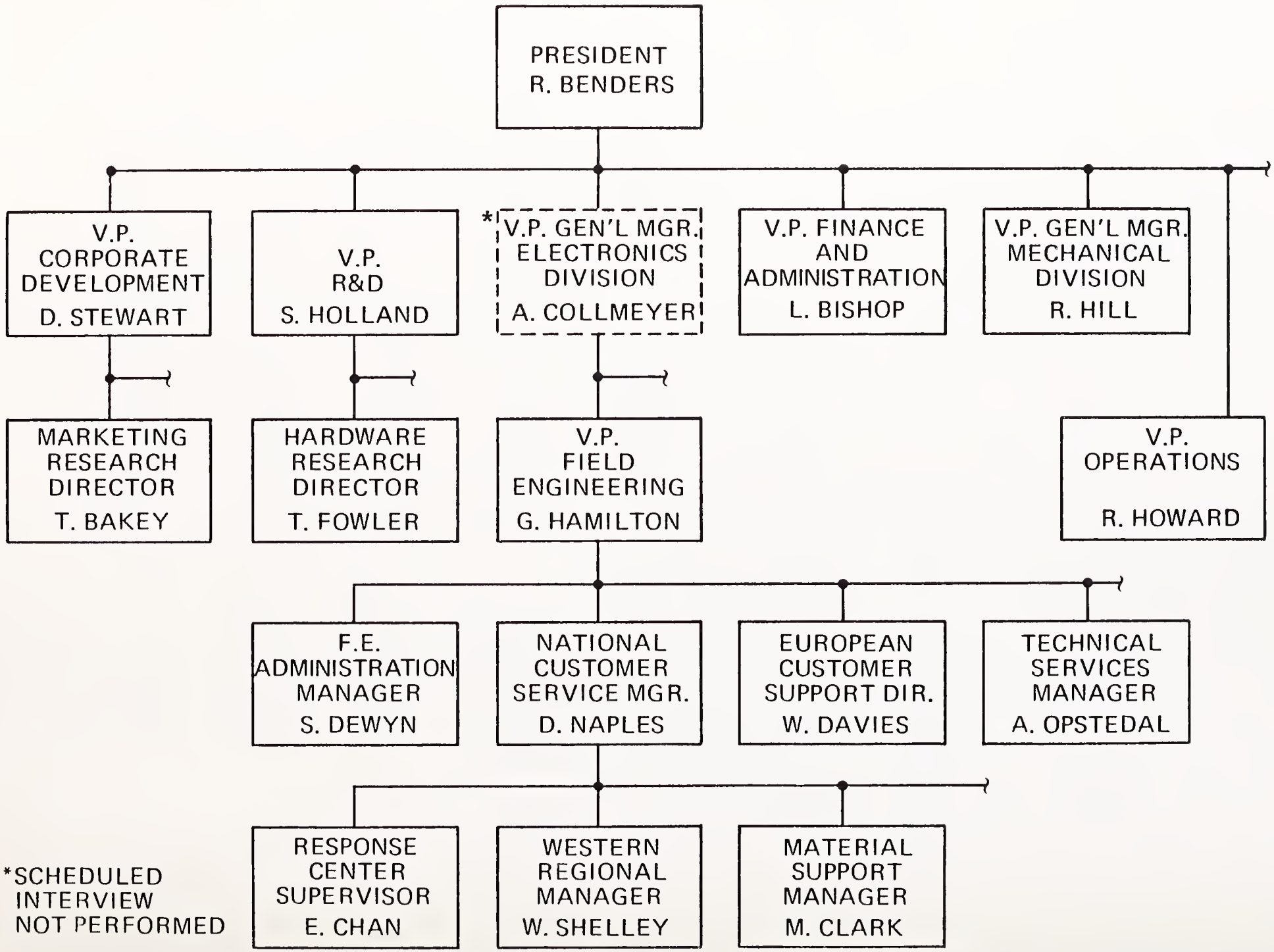
  - Determine the vendors most likely to supply CALMA's hardware over the next five years.

  - Qualify categories of users to determine a representative sample for testing attitudes and service expectations through 1985.

  - Qualify competitors who should have the greatest external influence on the direction of service to the CAD/CAM market over the next five years.

EXHIBIT III-1

CALMA INTERVIEWS



- Determine the characteristics of CALMA products to be offered in the near future. Examine maintenance aids to be designed into future equipment.

- Evaluate structure and personnel of the field engineering department relative to the defined mission and capability of expansion.

- Sixteen of the 17 scheduled executive interviews were conducted on CALMA's premises.

  - Key executives of all major operating departments and divisions were interviewed on-site, with the exception of the electronics division.

  - The general manager of the electronics division was unable to meet with INPUT at the appointed time.

B. PERCEPTIONS AND CONCERNS OF OTHER DEPARTMENTS REGARDING THE FE ROLE

- Perceptions of the role and quality of the field engineering group varied significantly among the other departments.

  - The different perceptions were unique to the limited requirements of the individual departmental missions, indicating an abnormal level of "tunnel vision" for a company at CALMA's stage of development.

    . R&D management tends to perceive field engineering primarily as personnel who maintain development systems. Secondarily, they expect FE personnel to offer some ideas in maintainability design of future equipment.

  - Production management perceives FE primarily as a competitor for spare parts and other demands on suppliers. Secondarily, they expect field engineering to provide better feedback for tracking performance curves, especially "infant mortality" problems.

  - Finance and corporate planning departments both perceive field engineering as a source of data collection for MIS, a cost center with no profit responsibility; but both departments complain that FE is not making a profit.

- The only perception of the fundamental mission of field engineering came from the mechanical division, which specified that FE's purpose was to:

  - Maintain the user-installed base in all respects.

  - Install new equipment.

  - Perform preventive and remedial maintenance.

  - Manage the image in the after-sales marketplace to assure repeat and referral business.

- No department outside field engineering perceives FE as both a potential source of stabilized revenue and a cash generator contributing to the profitability of CALMA.

- No other group except the mechanical division quickly perceives or acknowledges the vital, positive role field engineering must perform in order for CALMA to:

  - Grow at a 50% annual rate.

. Get repeat business.

. Get referrals for new business.

. Maintain shipping and installation schedules.

. Improve product quality in the field.

. Improve design quality.

. Solidify and stabilize vendor relations.

. Discover new applications.

. Maintain or increase market share.

. Become more profitable.

- The general motivation of other department managers at present appears to be to control field engineering in order to avoid mistakes rather than to free the department to make its own positive contribution.

- Some general concerns of the other department heads are shared by field engineering management:

  - Quality of FE personnel.

    . Incapable of diagnosing problems to the component level in accordance with stated CALMA maintenance philosophy.

    . Insufficiently trained to handle many problems, especially undefined "system" problems.

  - . Tend to over-specify spare parts when taking calls.

  - . Use too much "shotgun" effort in trouble shooting.

  - . Not systems-oriented.

- Quantity of FE personnel.

  - . FEs severely understaffed to handle total obligations.

  - . Manpower planning or justification basis is geared only to contracted maintenance instead of total exposure, leaving no flexibility to seek new revenue sources aggressively.

  - . Personnel shortage is resulting in an overloaded, critical customer list, effectively neutralizing the objectives of the escalation procedure.

  - . No flexibility for advanced training or planned attrition.

- Contract versus noncontract maintenance remains a general issue.

  - . A punitive attitude towards noncontract users is suggested in the remarks of CALMA management and perceived by some users.

  - . The ratio of contracted maintenance (below 50%) is far too low for the industry (competition running over 90% on contract).

  - . Users not on maintenance contract are not as easily managed as repeat or referral prospects.

  - . Low ratio of contracted users versus contingent obligations compounds problems in resource allocation and planning.

- Manpower planning.

- Spare parts planning.

- Management attention.

- Confused priorities.

C. CONCERNS OF FE MANAGEMENT

- Spare parts and inventory control problems are more visible internally to field engineering, but remain a concern to other management as well.

  - There is no data base on which to build usage and planning estimates.

  - There is no CALMA standard part numbering system.

  - There are no audit trails for reparable or unused parts.

  - No perpetual inventory system is in place.

  - Material requirements planning system for CALMA has no routine request for FE input.

  - Cost data for designing optimization algorithms are not available to the logistics manager.

  - Priority is given to retail parts sales over CALMA maintenance obligations.

  - Spare parts are used as diagnostics tools.

- Field engineering is not provided with a warranty account for spares used during customer warranty.

- Board level controls are inadequate.

- FE management believes that field engineering morale is lower than acceptable.

  - Field engineers lack a feeling of identification with CALMA.

  - Field engineers are confused on priorities:

    . Contract customer versus time-and-material users.

    . Determination of critical customers.

    . Hardware versus software.

  - Proprietorship is not practiced on a broad basis; too much "finger pointing."

  - Training and experience level is insufficient for the following job objectives:

    . Component-level repair philosophy.

    . System environment.

    . Applications environment.

    . After-market control.

  - Technical support backup is overloaded.

- Personnel are overextended.

- There is a shortage of spare parts.

- FEs feel like "step-children" by necessity rather than by design.

- Field engineering management recognizes that it must grow, individually and collectively, faster than CALMA's projected growth to catch up to challenges.

- Morale problems within the FE management ranks became evident during the interviews.

  - FE managers are generally concerned that other departments do not appreciate the fundamental objectives of field engineering.

  - They sense that they are perceived by other departments as a "necessary evil" rather than a potential for positive contributions to CALMA's future.

  - They believe that they are left out of the mainstream of communications.

  - Inexperienced and insufficient numbers of field personnel keep management in a constant state of crisis, thereby overloading their sensitivity to the exceptions.

  - Spare parts shortages create unnecessary repeat calls.

  - Excessive organizational changes add to existing morale problems.

  - Recent changes pushing the entire department one step further down from the president's office caused management morale to sink even lower.

- Further evidence of the sense of isolation felt by FE management is the level of "We . . . they . . . " that enters into comments regarding the FE relationship to CALMA.

- Internal polarization of attitudes is seen, but it does not appear as severe as the polarization of the attitudes of the entire FE department toward the rest of CALMA, and vice versa.

- A resulting negative trend is detectable in that energies will become increasingly directed toward defensive tactics covering one's own position, and away from optimistic contributions to departmental goals.

- As in other departments at CALMA, perceptions of the FE role vary according to parochial concerns.

  - The focal point of each departmental objective is internal to the department rather than to the overall objectives of field engineering and CALMA.

  - As in the case of the mechanical division, the clearest perception of the FE role is held by the line organization, which ultimately must implement the fundamental FE objective of maintaining the installed base.

- Field engineering lacks strong vendor interface and must rely on supplier/buyer relationships in the operations department.

- MBO plans have been defined to address several problem areas in technical operations:

  - Insufficient documentation controls.

  - Unreliable systems diagnositics.

  - Inadequate training for corporate objectives.

  - Machine- and board-level controls not in place.

- Technical coordinator to Europe is not experienced in dealing with unique problems facing the Europeans.

- FE managment lacks a strong sign-off position in system configuration control and maintainability design.

- FE management has no firm acceptance criteria or firm position with respect to systems certified as qualified for shipment to users.

- There is no accurate data base for computing MTBF, MTTR and other statistics vital to good planning in field engineering.

- The profit contribution made by field engineering cannot be measured by current accounting methods, which list:

  - No credits for warranty service and parts.

  - No credits for the maintenance of CALMA's internal systems.

  - No credits for installation workload.

  - No transfer rates for services exchanged between divisions and other departments.

  - No standardized cost data for spare parts investments and usage.

- Operational measurements of performance by the field engineering department are not consistent with overall objectives.

- The field engineering department is no longer a centralized function capable of independent judgement in prioritizing the service needs of all competing divisions and departments.

D. USERS AND COMPETITORS SELECTED FOR PHASE TWO

- As a result of interviews with all CALMA executives, a user list was compiled for telephone interviews.

  - The originial list was slightly modified to reflect a more desirable balance between electronic and mechanical users, and to shift geographical emphasis more towards the western region.

  - The final user list is discussed in more detail in Chapter V.

- Competitors and potential competitors were ranked according to priority in discussions with the vice president of field engineering. Details of competitor interviews are in Chapter VI.

IV VENDOR ANALYSIS

IV VENDOR ANALYSIS

A. TELEPHONE SURVEY OF VENDORS

- Telephone interviews were conducted with 17 vendors and potential vendors of key peripheral equipment for the industry, as shown in Exhibit IV-1. The products offered by these vendors were as follows:

  - CPUs.
  - Disk drives.
  - Tape drives.
  - Tape controllers.
  - Disk controllers.
  - Test equipment.
  - Graphics monitors.
  - Plotters.
  - Third-party maintenance vendors.

EXHIBIT IV-1

VENDOR INTERVIEWS

•	CPU (3)	*DIGITAL EQUIPMENT HEWLETT-PACKARD **DATA GENERAL
•	DISK DRIVES (6)	*PERTEC *CDC *MEMOREX STORAGE TECHNOLOGY PRIAM SYSTEMS INDUSTRIES
•	CONTROLLERS (2)	MICROCOMPUTER SYSTEMS CORP. WESTERN PERIPHERALS
•	TAPE DRIVES (4)	x*PERTEC *CIPHER KENNEDY xSTORAGE TECHNOLOGY

*ON-SITE

**TELEPHONE INTERVIEW CONDUCTED AS ON-SITE TO BE FOLLOWED WITH ON-SITE IN PHASE-2

x INTERVIEWED IN SECOND CATEGORY

I SEPARATE INTERVIEWS WITHIN SAME COMPANY BY AND WITH DIFFERENT LEVELS OF MANAGEMENT

INF

EXHIBIT IV-1 (CONT.)

VENDOR INTERVIEWS

• GRAPHICS (3)	GENISCO HAZELTINE LEXIDATA
• PLOTTERS (3)	*CALCOMP *VERSATEC XYNETICS
• TEST EQUIPMENT (2)	*TEKTRONIX MILLENIUM SYSTEMS
• THIRD-PARTY MAINTENANCE (4)	x*CDC[I] COMMA (CDC) TRW INDESERV RAYTHEON

*ON-SITE

**TELEPHONE INTERVIEW CONDUCTED AS ON-SITE TO BE FOLLOWED WITH ON-SITE IN PHASE-2

x INTERVIEWED IN SECOND CATEGORY

I SEPARATE INTERVIEWS WITHIN SAME COMPANY BY AND WITH DIFFERENT LEVELS OF MANAGEMENT

- Fifteen of the 17 vendors reported that they maintained end user equipment. Of the two vendors not maintaining end-user equipment, one relies on third-party maintenance vendors while the other only maintains the equipment of the OEMs to which they market.

- Exhibit IV-2 designates the titles of the individuals contacted during the course of telephone and on-site interviews.

- The most commonly mentioned problem concerning the maintenance of end user systems was that of maintaining an adequate supply of spare parts to meet the rapidly increasing needs that result from the constantly expanding installed base of equipment. Respondents expressed additional concern about creating adequate logistics procedures to ensure the timely distribution of those parts on hand.

I. DESIGN SITE MAINTENANCE OUT OF SYSTEMS AND PERIPHERALS

- The vendors surveyed during this portion of the study were universally concerned with the increasingly labor-intensive nature of field maintenance. It is agreed that simply increasing the size of the field engineering staff will not solve the problem of the labor component of equipment maintenance expense. As a direct result of this concern, all respondent vendors feel that they need to design their way out of the site maintenance business. While each vendor will have its own unique approach to the problem, the following represents those strategies and techniques that reflect the common themes of all vendors surveyed, as shown in Exhibit IV-3.

- Respondent vendors believe that remote diagnostics will play an increasing role in the reduction of labor costs within the next five years. Vendors do not plan to retrofit older equipment to ensure remote diagnostics capabilities, but they do feel that future equipment must have, as a minimum, built-in diagnostics that will perform fault-isolation prior to the actual dispatch of an FE. Thus in most cases the FE will arrive on-site with the necessary parts to repair the system. Users will also tend to become more involved in the maintenance process.

EXHIBIT IV-2

TITLES OF INDIVIDUALS INTERVIEWED

PRODUCT MARKETING MANAGER	
PLANT TECHNICAL OPERATIONS MANAGER	
PRODUCT MANAGER	
FIELD ENGINEERING DIRECTOR	(8)
OEM PRODUCT SALES MANAGER	
GENERAL MANAGER ENGINEERING SERVICES	
EX-PRESIDENT OF THIRD-PARTY MAINTENANCE	(2)
TECHNICAL OPERATIONS PLANNING MANAGER	
SENIOR PLANNING ANALYST, F.E.	
TECHNICAL OPERATIONS MANAGER	
PRODUCT PLANNING DIRECTOR	
AREA FIELD SERVICE MANAGER	
REGIONAL SERVICE MANAGER	
NATIONAL FIELD SERVICE MANAGER	(4)
DIRECTOR OF SERVICES	
SUPERVISOR OF FACILITIES ENGINEERING	
CUSTOMER SERVICE MANAGER	(3)
REGIONAL SALES ENGINEER	
DIRECTOR OF CORPORATE COMMUNICATIONS	
DIRECTOR OF TECHNICAL SERVICES	
MANAGER OF PRICING PROPOSALS	
DIRECTOR OF MARKETING	(2)
VICE PRESIDENT OF FIELD ENGINEERING	

37 INDIVIDUALS CONTACTED

EXHIBIT IV-3

VENDOR ISSUES/TOPICS

- DESIGN SITE MAINTENANCE OUT OF SYSTEMS AND PERIPHERALS BY YEAR 2000
  - COMMON THEME AMONG MANUFACTURERS
  - REMOTE DIAGNOSTICS
  - THROW-AWAY MODULES/UNITS
  - DEPOT/FACTORY REPAIR OF MODULES/UNITS
  - UNBUNDLING OF MAINTENANCE
  - SYSTEM SUPPORT CENTERS
  - SELF-ADJUSTING REPLACEMENT MODULES
- 1980-1985 TIMEFRAME DEDICATED TO EXPERIMENTATION OF MOST SOPHISTICATED DEVICES TO REDUCE SITE MAINTENANCE
  - EFFORTS TO ESTABLISH COMMON TEST PLUG INTERFACE FOR PROGRAMMABLE SIGNATURE ANALYSIS TYPE TEST DEVICES
  - TEST USER ACCEPTANCE OF CONCEPTS
  - ADDRESS SOCIOLOGICAL IMPACT ISSUES
  - COST/BENEFIT ANALYSIS OF REMOTE DIAGNOSTICS IN SERVICE

EXHIBIT IV-3 (CONT.)

VENDOR ISSUES/TOPICS

- TEST EQUIPMENT REQUIREMENTS
  - SCOPES REQUIRED IN FUTURE ARE ALREADY AVAILABLE; E.G., TEKTRONIX 475 IS SUFFICIENT
    - . THROUGHPUT IMPROVEMENTS NO LONGER FROM FASTER GATES AND FASTER CLOCKS
    - . OPTIMIZE TRANSACTION PROCESSING WITH OUTBOARD MICROPROCESSING AND MULTIPROCESSING UNITS
  - BRANCH/DISTRICT SPECIALISTS WILL REQUIRE LOGIC ANALYZERS TO TRAP RANDOM SIMULTANEOUS EVENTS LEADING TO FAILURES DIFFICULT TO ANALYZE
  - BUILT-IN MICROPROCESSOR-DRIVEN TESTING BROUGHT TO PANEL OR PLUG FOR ADDITIONAL ANALYSIS AND EXERCISING
  - PROGRAMMABLE BOARD TESTERS FOR REPAIR DEPOTS

EXHIBIT IV-3 (CONT.)

VENDOR ISSUES/TOPICS

- MANPOWER MORE CRITICAL 1980-1983 THAN 1985 AND BEYOND
- NEAR-TERM TRENDS OF VENDORS TOWARDS STANDARDIZED OEM CONTRACTS IN KEY AREAS:
  - SPARE PARTS FORECASTS
  - FCO CONTROLS
  - DOCUMENTATION STANDARDS
  - DIAGNOSTIC RELIABILITY
  - ESCALATION PROCEDURES BEFORE CALLING VENDOR
  - AGREEMENTS TO USE REGIONAL REPAIR CENTERS
  - CONTROLS ON THIRD-PARTY ACTIVITY/OBLIGATIONS
- MINIMIZING MECHANICAL APTITUDE REQUIREMENTS
- GENERAL RELUCTANCE TO OFFER THIRD-PARTY MAINTENANCE TO PARTS OF SYSTEMS NOT MANUFACTURED BY VENDORS

EXHIBIT IV-3 (CONT.)

VENDOR ISSUES/TOPICS

- OEM FEEDBACK
  - "INFANT MORTALITY" RATES
  - MTBF
  - MTTR
  - FAILURE DESCRIPTIONS
  - MARKET REQUIREMENTS - FUTURE PRODUCTS
  - TECHNICAL TIPS TO SHARE
- CONCERNS ABOUT MAINTENANCE COSTS RELATIVE TO HARDWARE COSTS
- QUALITY OF OEM MANAGEMENT
- UNIQUE APPLICATIONS DEMAND STRAINING EQUIPMENT AND SOFTWARE TOLERANCES
- INCREASING INHERENT RELIABILITY UNDER "STRESS" CONDITIONS

- Respondent vendors also expect that depot-level maintenance will help reduce the labor cost component of maintenance expenses. Vendors are genuinely concerned about the rapidly increasing cost of transportation as it impacts the provision of on-site response to all service requests from customers. A significant portion of an FE's time is spent in transit between customer locations - time that could be more efficiently spent in the actual repair of equipment at a central location. Vendors see the time approaching (if not already arrived) when it will be much more cost effective to send the equipment to the maintenance center than to bring the maintenance center (the FE) to the equipment.

  - A vendor of graphics monitors is presently offering a terminal that has only one board. Users are provided with a set of diagnostic procedures to implement in the event of equipment failure. If the diagnostics indicate a fault with the board, a new board is pre-shipped as a replacement and the failed board is sent to a depot for maintenance. Depot-level maintenance is the only type of maintenance available on this particular equipment. User reaction to this procedure has been quite favorable, since a stated 98% of all failures are resolved in less than 24 hours.

- Vendors see throw-away modules and units as a distinct possibility in the future, although they are not certain whether this transition will occur by 1985. Third-party vendors indicated concern over the ever-decreasing cost of hardware in relation to the continuing increase in the rate of labor. These vendors see the time approaching when the repair of a typical system will involve merely replacing the faulty unit or module and discarding rather than repairing it.

- Unbundled maintenance contracts are also seen as a way of presenting each component of the total full-service contract. The more labor-intensive elements can be priced according to the actual cost of providing the individual benefits.

- Six of the 17 vendors surveyed have installed system support centers in order to screen all service requests so that an FE is not dispatched to a site unless it is absolutely necessary. The centers also provide an efficient means of directing the dispatch of proper service personnel and assigning priorities to service requests according to the severity of the problems.

2. EXPERIMENTAL NATURE OF 1980-1985 MAINTENANCE PLANNING ACTIVITIES

- Over the next five years, vendors expect to assess a variety of options for decreasing the cost of maintenance. During this time, concepts of remote diagnostics and systems support centers will be evaluated for cost/benefits and user acceptance. Vendors are also aware of the socio-economic implications of eliminating a large number of jobs from the economy by their efforts to obviate the maintenance requirements of future product offerings.

- Vendors note that users are generally reluctant to become actively involved in maintenance. At the same time, they are aware of their inability to provide full-service coverage for their entire installed base in a manner that would meet current user standards of excellence for field maintenance.

3. PERSONNEL REQUIREMENTS

- Vendors report that the critical period for skilled personnel availability will be between 1980 and 1983, becoming less severe after that. During that time, vendors plan to significantly increase the reliability of future product releases. This increase in equipment reliability is not motivated by a desire for improved inherent quality, but by economic realities in the expected trade-off of maintenance costs associated with equipment of today's reliability. There will not be enough of these future product offerings to slow the present trend toward increasing personnel requirements.

4. MINIMIZING MECHANICAL APTITUDE REQUIREMENTS

- Respondent vendors state a trend toward reducing the mechanical nature of future product releases in their attempt to increase equipment reliability. As a side effect of this practice, future FEs will no longer need to have any significant degree of mechanical aptitude in order to perform their required duties adequately. These vendors believe that by reducing the mechanical aptitude necessary to repair the equipment, it would not be too difficult for end users to perform a good deal of maintenance traditionally associated with professional field engineering.

5. VENDORS AS THIRD-PARTY MAINTENANCE SOURCE

- The vendors surveyed are universally opposed to acting as third-party maintenance sources for equipment not manufactured by them. They stress the fact that they are having a difficult enough time dealing with their own increasing demands for service and do not want the additional responsibility of equipment maintenance for other vendors' equipment.

6. TEST EQUIPMENT REQUIREMENTS

- Respondent vendors indicate that the present test equipment is more than sufficient to meet maintenance requirements. In many respects it is the vendors' view that the FEs on staff today do not have the skills or sophistication to properly use the test equipment now available to them, and vendors do not expect this to change within the next five years.

  - Vendors expect that test equipment of the future will consist of built-in, microprocessor-driven testing that is brought to a panel or plug for additional analyzing and exercising.

  - Programmable board testers will be required at the depot level, where most actual repair activity will be performed.

- Branch/district specialists will require logic analyzers to trap the random simultaneous events which precede failures that are difficult to analyze.

7. OEM FEEDBACK

- The 1980-1985 period will be a time for increased vendor/OEM communication in an effort to address informational needs more effectively, allowing for greater reliability in the design of future product offerings.

- Historical data bases should be maintained in an effort to avoid such problems as "infant mortality" in future product offerings.

8. QUALITY OF OEM MANAGEMENT

- Many of the surveyed vendors expressed concern over the ability of current OEM management to deal effectively with the forecasted growth rates predicted for CAD/CAM. They suggested that far too much attention has been paid to preparing for a theoretical surge in product demand, while not nearly enough has been paid to eliminating current problems, such as parts inventories and distribution. As one respondent put it:

  - "They're trying to run with the ball before they've caught it."

B. ON-SITE OEM VENDOR SURVEY

- Eight OEM vendors were interviewed on-site, as shown in Exhibit IV-1.

- The purpose of on-site interviews was to reinforce and complement telephone interviews, to discover additional significant trends available from unstructured dialogue, and to remove ambiguities that might result from the more structured telephone interviews.

- All vendors stated that they are working toward standardization of OEM agreements in the next few years, including:

  - Standard commitments on spare parts forecasts and firm-order placements. (Typically six months for forecasts, three months for firm.)

  - Standard agreements on controls and classifications of FCOs (Field Change Orders).

  - Standard agreements on documentation controls and standards.

  - Standard maintenance support agreements.

    . Escalation requirements.

    . Backup support.

    . Training of OEM personnel.

    . Repair facilities.

  - Diagnostic reliability standards with specific allowances for modifications required for multiple interfaces.

  - Standard obligations under third-party arrangements.

  - Standard warranties.

- On-site interviews reinforced the results of telephone interviews regarding test equipment needs.

- In the future, throughput of systems will be increased more by control of information and optimization of multiple microprocessors than by faster clocks and faster logic gates.

  . Present oscilloscopes are fast enough to handle future systems.

  . More sophisticated portable logic analyzers will be required to trap random simultaneous events leading to failures.

- More versatile programmable signature analysis equipment should be available, provided that a standard can be established for common tester interface logic.

• On-site vendor interviewees expanded on the topic of OEM feedback.

- Vendors as a group welcome conferences with OEM customers to discuss problems and recommend solutions.

- Vendors would like to hear more about end user needs in future product designs.

- Especially important to vendors is improved data collection on equipment failure and repair times.

  . Accurate tracking of design reliability.

  . Tracking of the effectiveness of improvements and enhancements.

  . Early warning of troubles before they reach crisis proportions.

  . Effectiveness of diagnostic aids.

- All other topics discussed with vendors on-site touched on the same issues raised in telephone interviews. No significant variance in attitudes between the two groups of interviewees was detectable.

V USER ANALYSIS

V USER ANALYSIS

A. SURVEY OF USERS

- Twenty users of CALMA CAD/CAM interactive graphics systems were interviewed for this portion of the study. As shown in Exhibit V-1, sample was distributed as follows:

  - Ten on-call.
  - Ten on-contract.
  - Ten large.
  - Ten small.
  - Sixteen electronic applications.
  - Four mechanical applications.
  - Eight western area.
  - Six central area.
  - Six eastern area.

EXHIBIT V-1

CLIENT-AUTHORIZED REVISIONS TO
QUESTIONNAIRE SAMPLE

ATTRIBUTE	PLANNED	REVISED
GEOGRAPHY	7 WEST 7 CENTRAL 6 EAST	8 WEST 6 CENTRAL 6 EAST
CONTRACT STATUS	10 ON CONTRACT 10 ON CALL	10 ON CONTRACT 10 ON CALL
SIZE	12 LARGE 8 SMALL	10 LARGE 10 SMALL
APPLICATION	8 MECHANICAL 12 ELECTRONIC	4 MECHANICAL 16 ELECTRONIC

- Although the majority of users had only one system installed at their site, several had multiple installations. The twenty respondents had a total of 34 units in place, with one site having nine. Exhibit V-2 shows the distribution of systems by CALMA model number.

- Most respondents were managers or chief engineers of the CAD/CAM section within each company or division.

- The annual corporate revenues of respondent companies ranged from $12 million to $6 billion. Seven of the respondents reported annual corporate revenues in excess of $1 billion.

B. ANALYSES OF SURVEY RESULTS

1. EFFECTIVENESS OF PRESENT SYSTEM

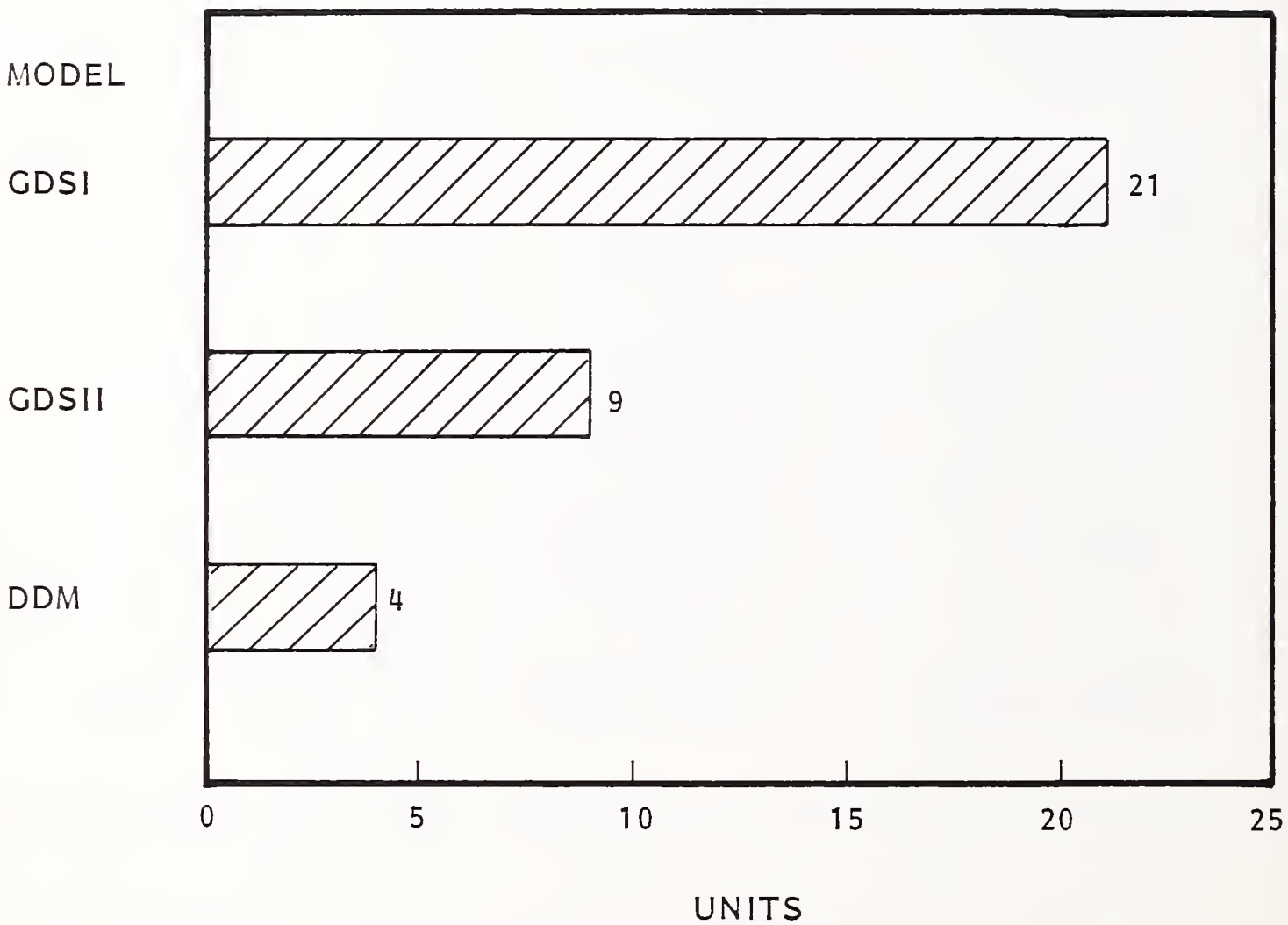
- Two of the 20 respondents indicated that their system was not presently able to meet the requirements imposed by their particular application. These two users were both small West Coast organizations using GDSI in the design and manufacture of PC boards. Reasons given for inadequacy were the memory and speed limitations of the GDSI as they related to the requirements imposed by automatic routing.

- Of the 18 respondents indicating that their present systems are meeting the requirements of their applications, nine state that the present systems are only marginally meeting those requirements. Again, the most frequently mentioned limiting factors were memory and speed.

- Forty percent (eight of 20) indicate that by the year 1983, their present systems will be unable to meet their demands. All of these respondents are involved in the electronics applications of CAD/CAM. An additional three respondents indicated that their present systems will be able to handle future

EXHIBIT V-2

DISTRIBUTION OF CALMA
SYSTEMS IN USER SAMPLE



INPU

requirements with a great deal of software enhancement if they can off-load a large portion of the computational activity to larger computers.

- By the year 1985, 60% (12 of 20) expect that their present systems will be unable to meet the more demanding requirements imposed by future technology. Of these 12 users, 11 were involved in electronic applications and one was using the system for mechanical tool design.

- Several of the users suggested that vendors of today's systems should realize that they are not going to be able to provide standalone systems for the entire design cycle. They stress that the value of the present systems is not in their ability to meet all design requirements, but rather in their ability to permit the human/machine manipulation of graphical data in an efficient manner while transferring the increasingly complex computational activities to larger mainframes.

2. CHANGES IN WORKLOAD

- As shown in Exhibit V-3, the average system of those surveyed was in use for 1.9 shifts per day. There is also a reported trend for that workload to increase during the next five years. By 1985, virtually all survey respondents will have increased the number of shifts per day that their system is now in operation. This is demonstrated by the fact that, while six of the 20 respondents are presently using their system one shift per day, only one of the respondents expects to be a one-shift operation by 1985.

3. USER RATING OF MAINTENANCE

- As shown in Exhibit V-4, respondents rated both the hardware and software as of "average quality." The figures reported in this exhibit are based on 17 responses, since only seven of the "on-call" users are actually receiving their service from CALMA. The other three users were receiving their equipment maintenance from either third-party firms or the original equipment manufacturer.

EXHIBIT V-3

USER
FORECASTED
WORKLOAD CHANGES,
1980-1985

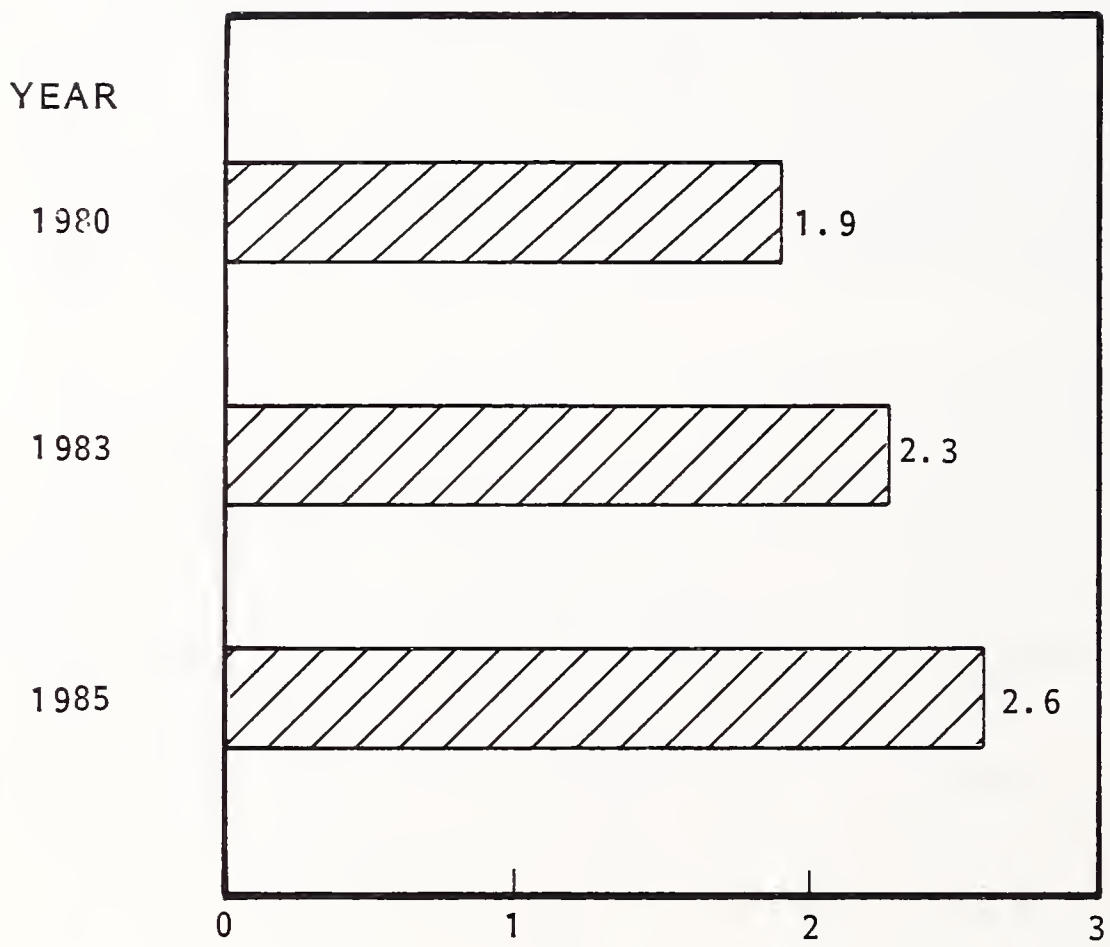
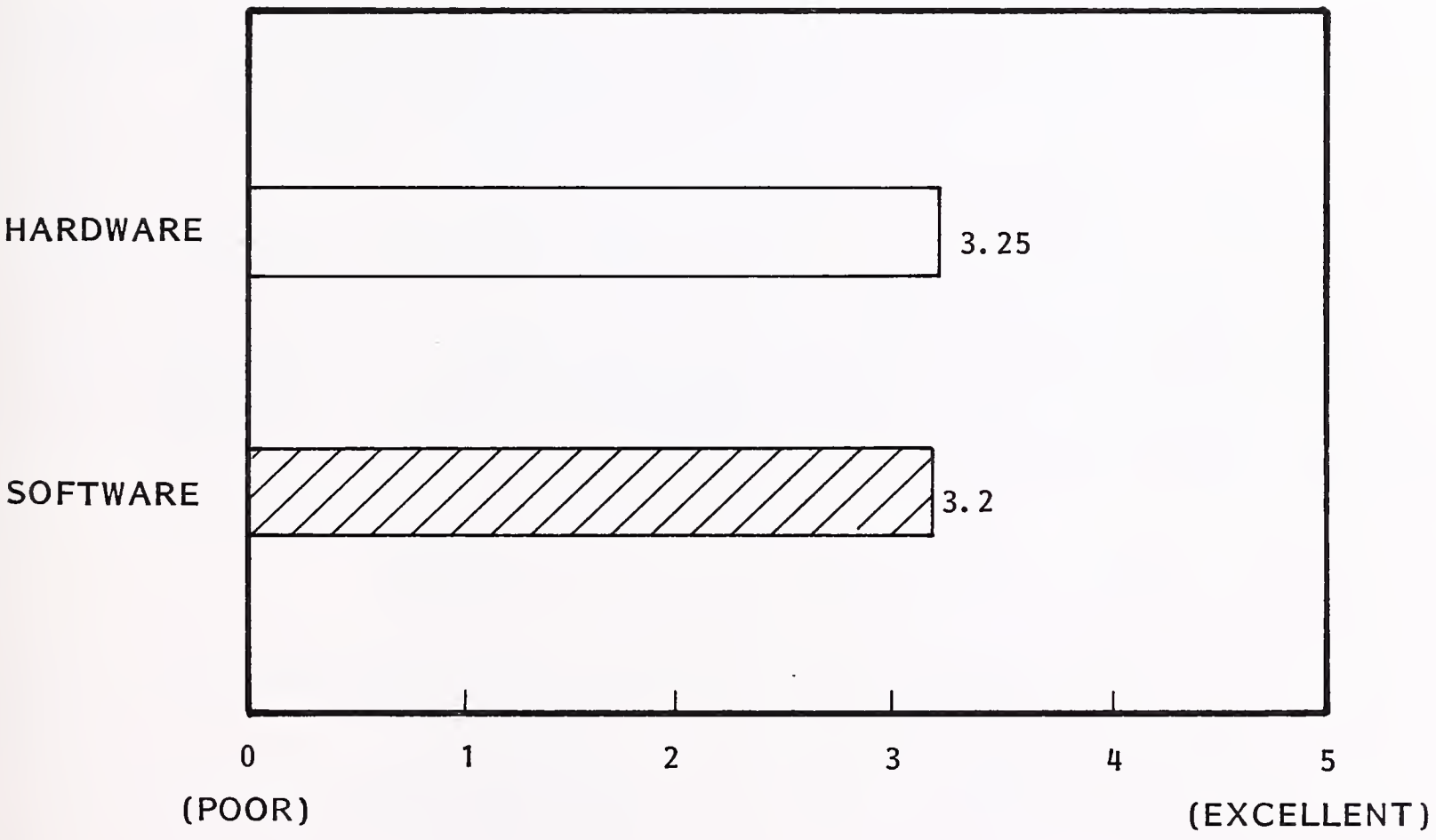


EXHIBIT V-4

USER RATING OF HARDWARE AND SOFTWARE MAINTENANCE



- It is important to note that the on-call customers of CALMA report a higher degree of satisfaction with the quality of maintenance they are presently receiving than do their counterparts who are receiving their service under contract with CALMA. Conversations with the on-call users indicate that they were told that their on-call status meant that their problems would be assigned a lower priority than those of the on-contract customers, and thus they were led to expect a poorer level of response to their maintenance needs than were the on-contract group. Those users receiving service under contract with CALMA feel that they should be receiving the level of service either stated or inferred during the system acquisition phase.

4. SERVICE CONTRACT RENEWAL

- The ten respondents who presently have maintenance contracts all indicated that they would continue to contract for their maintenance needs. Three of the ten, however, indicated that future maintenance contracts would probably be with either the original equipment manufacturer or a third-party maintenance vendor, rather than CALMA. When pressed for further information, these three respondents indicated that, given the forecasted growth of the CAD/CAM market, a third party might be better able to perform maintenance because it would not have the pressures of new systems placement impinging on its performance.

5. MAINTENANCE CONTRACTS FOR FUTURE SYSTEMS

- None of the respondents in the on-call category indicated that they would purchase maintenance contracts from the system vendor for future CAD/CAM systems. Users indicated that they expect future equipment to be sufficiently reliable to counteract the need for service contracts. As one respondent put it:

  - "For the price of a service contract, given the reliability of the equipment, we can afford to hire somebody, train him, buy him some spare parts, and let him stand around until it breaks."

- All of the respondents who are presently under contract to CALMA for their maintenance requirements, report their intent to purchase maintenance contracts for future systems. Six of those ten also report that, while it is their present intention to purchase a maintenance contract, the actual decision will be made on the basis of a cost/benefit analysis which will be performed at the time of purchase. Present value analysis will be used in these six cases.

6. WILLINGNESS TO PAY FOR 24-HOUR, SEVEN-DAY COVERAGE

- Only four of the 20 respondents indicated a willingness to pay any amount in addition to the standard price of a full-service contract to receive 24-hour, seven-day coverage on their systems. It was the consensus of the respondents presently on contract that the going rate for a service contract is high enough to warrant two shifts of coverage per day.

7. USER INVESTMENT IN SPARE PARTS

- Seventeen of the respondents stated an unwillingness to lease or purchase spare parts for use with their systems. The most frequent comment regarding spare parts inventories was that this capital expenditure is more properly associated with the supplier of the system.

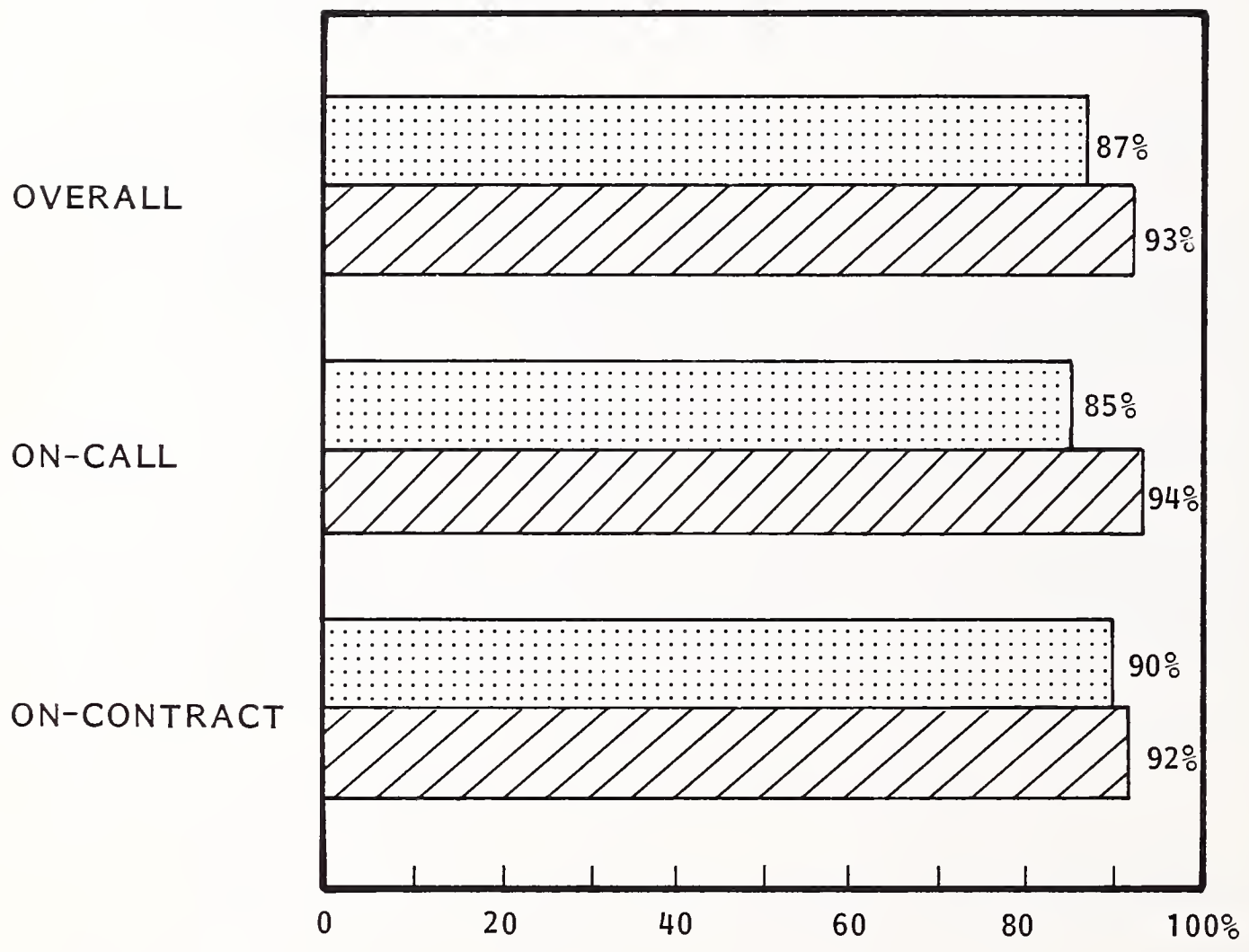
- The three respondents who indicated a willingness to invest in spare parts agreed that 10% of system cost would be the maximum amount.

8. MINIMUM ACCEPTABLE VERSUS ACTUAL PERFORMANCE LEVELS OF FIELD SERVICE

- As shown in Exhibit V-5, respondents reported an average uptime of 93%, which is significantly higher than the average acceptable performance of 87%. The 87% average acceptance figure is distorted by one user who recently installed a GDSII requiring only 40% availability at present.

EXHIBIT V-5

USERS'
MINIMUM ACCEPTABLE
VERSUS ACTUAL LEVELS FOR
PERCENT UPTIME



- Small users reported an average minimum acceptable uptime of 90%, as compared to an average minimum uptime of 85% for large users. The large users would have also reported a minimum acceptable uptime of 90% if one discounts the distortion caused by the one GDSII user requiring only 40%.

- On-call respondents reported an average minimum acceptable uptime requirement of 85%, while those respondents having a maintenance contract for service with CALMA reported a minimum acceptable uptime level of 90%.

- The twenty respondents reported an overall actual average of 93%.

  - Small users reported receiving an actual average uptime of 93%, as compared to their on-contract counterparts, who reported an average actual uptime of 92%.

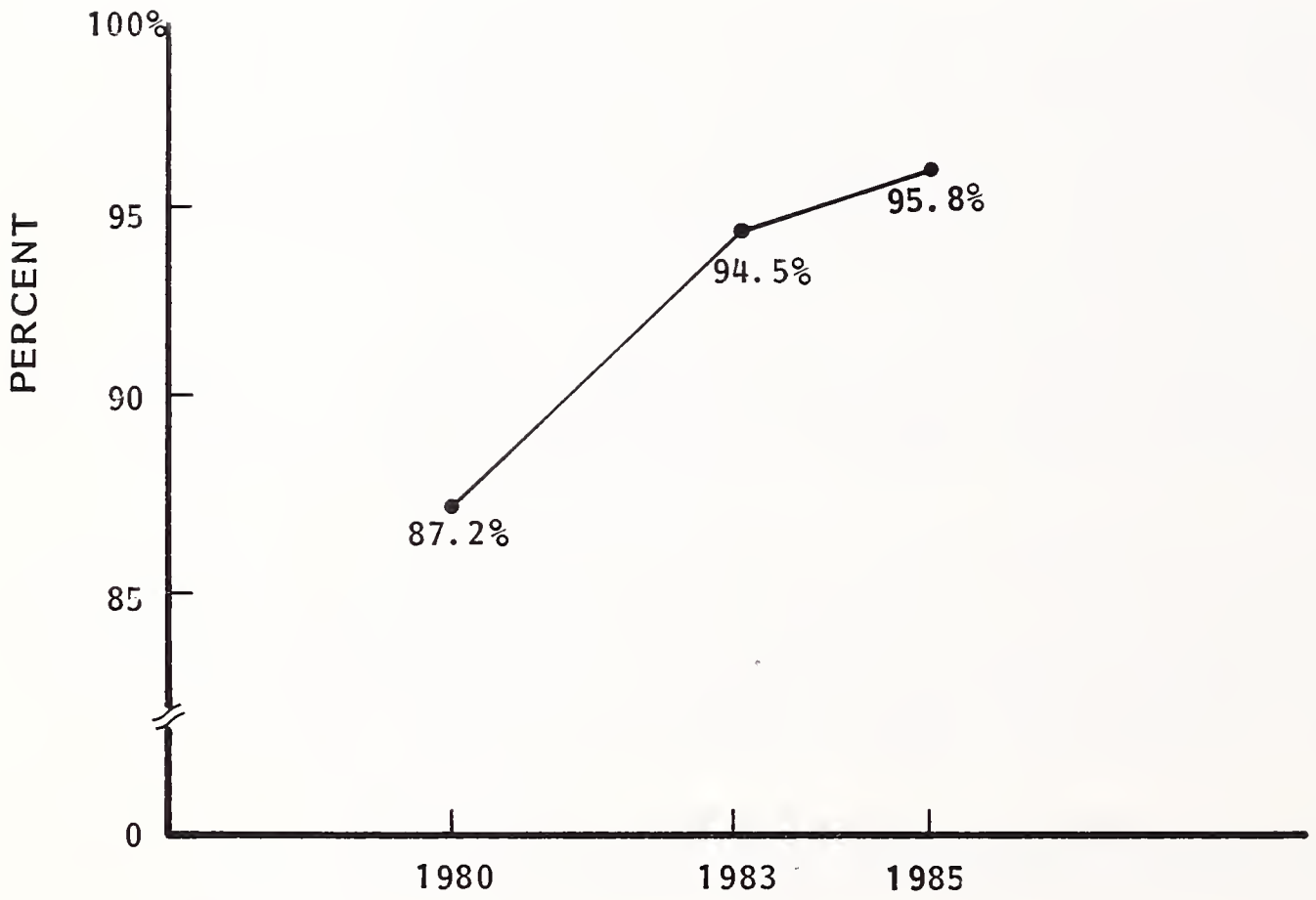
  - On-call users reported receiving 94% uptime on the average, while users on contract reported an average actual uptime of 92%.

  - On a regional basis, the western service area reports the lowest level of actual uptime, at 90%. This is due to two large electronics users (one on-call, one on-contract) reporting actual uptime of only 80%.

- All users reported that the next five years will show a trend toward substantial increases in the minimum acceptable percentage uptime required for their systems operations. The present average minimum acceptable uptime of 87% will increase to 94.5% by 1983, and to 95.8% by 1985, as shown in Exhibit V-6. Respondent users, on-call versus on-contract and small versus large, show no apparent differences in their estimates of their minimum acceptable uptime requirements.

EXHIBIT V-6

USERS'
PROJECTED TRENDS FOR
PERCENT UPTIME REQUIREMENTS,
1980-1985



- Respondents reported a minimum acceptable level for mean time between failures (MTBF) of 2.7 months, while also reporting an actual MTBF of 1.7 months, as shown in Exhibit V-7.

  - Large users reported an average acceptable MTBF of 2.8 months, while the small users reported an MTBF of 2.6 months.

  - On-call users reported a minimum acceptable MTBF of 3.0 months versus an average minimum acceptable MTBF of 2.4 months for customers on contract.

  - Large users reported an actual average MTBF of 2.2 months, while small users reported a corresponding figure of 1.2 months.

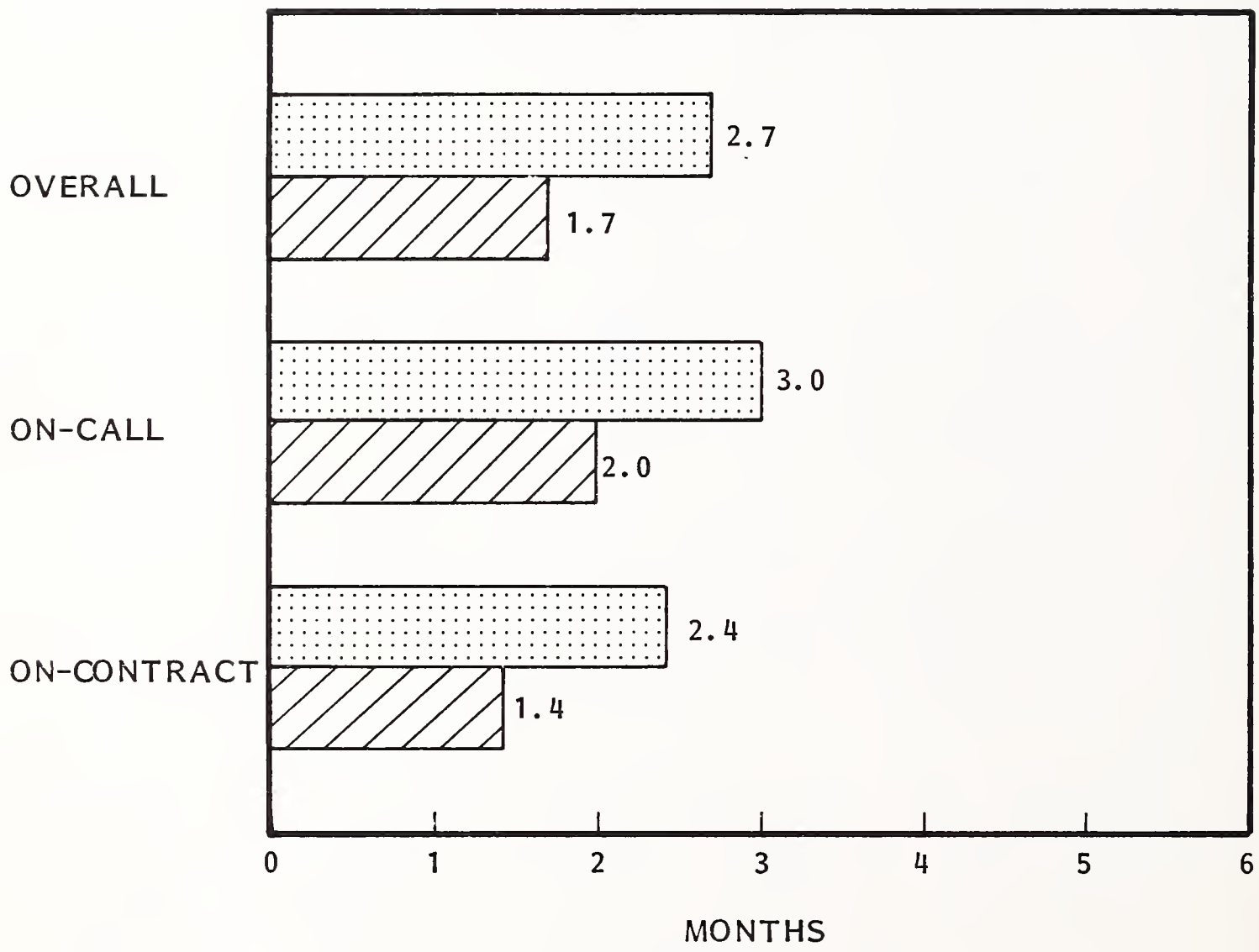
  - Users who are on maintenance contracts reported an actual average MTBF of 1.4 months, while the on-call respondents showed an actual average MTBF of 2.0 months.

  - Evaluated on a regional basis, those respondents in the eastern and central service areas reported an actual average MTBF of 2.2 months, as compared to an actual average MTBF of 1.0 months for those respondents in the western service area.

- Respondent users indicated that, during the next five years, their minimum acceptable levels for MTBF will show a substantial increase. By 1983, an average minimum acceptable level for MTBF will rise to one failure every 4.9 months, and in 1985 this minimum acceptable level for MTBF will again increase to an average acceptable level of one failure every 5.5 months, as shown in Exhibit V-8. In their comments, most user respondents indicated that they were planning to replace their present system during the next five years and fully expected the equipment of the 1980s to demonstrate these levels of reliability.

EXHIBIT V-7

MINIMUM ACCEPTABLE
VERSUS ACTUAL LEVELS FOR MTBF
(MEAN TIME BETWEEN FAILURES)



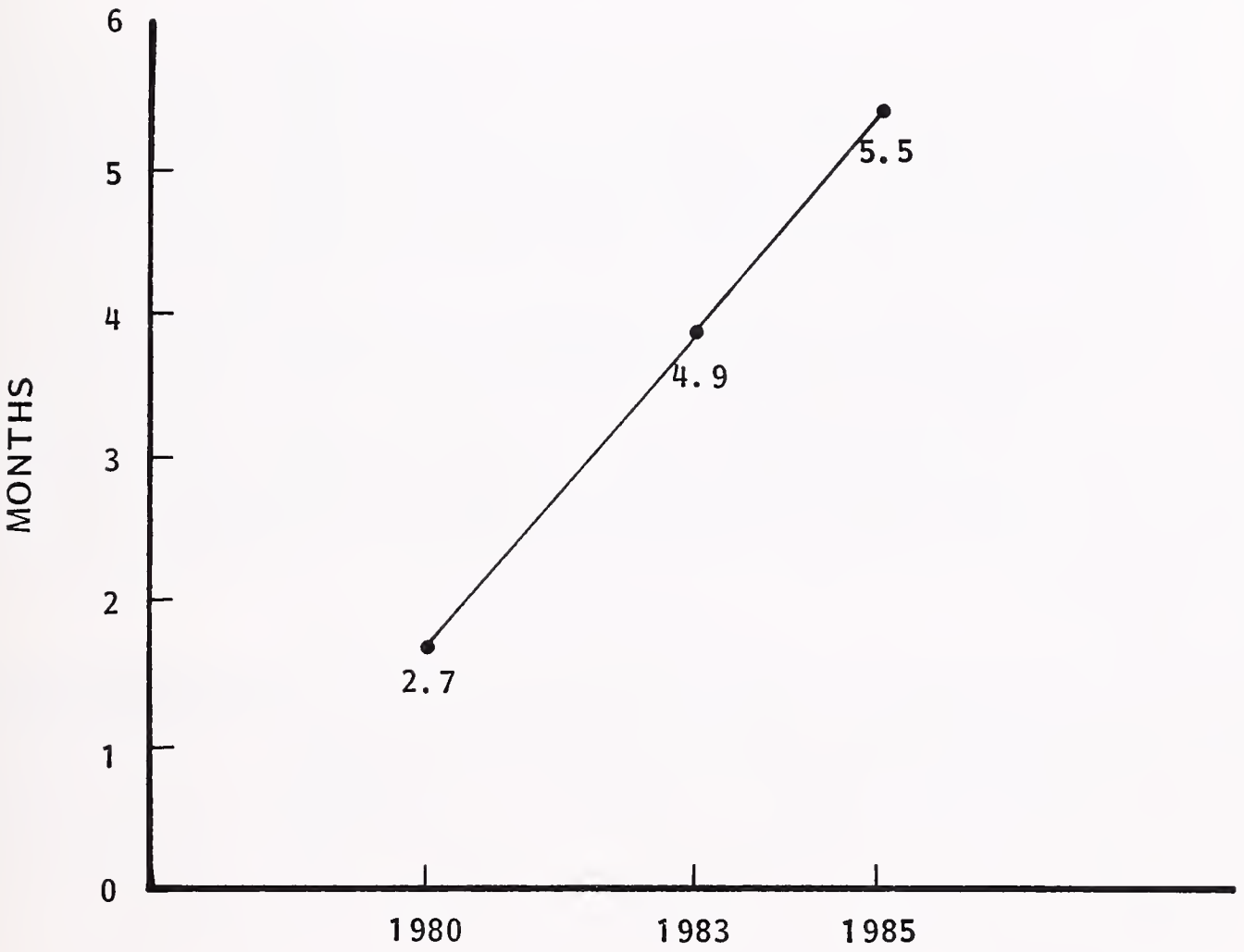
MINIMUM ACCEPTABLE

ACTUAL

INPU

EXHIBIT V-8

PROJECTED TRENDS FOR
MTBF, 1980-1985



- Survey participants reported a minimum acceptable level for mean time to respond by telephone (MTTRt) of 6.1 hours, as shown in Exhibit V-9.

  - There was a significant split between large and small users, with large users reporting an average minimum acceptable MTTRt of 7.9 hours, while small users reported 4.3 hours as a minimum acceptable level.

  - On-call respondents reported an average of 8.0 hours, as contrasted with an average minimum acceptable requirement of 4.2 hours for those survey respondents on contract.

  - The actual MTTRt reported by respondents was 9.7 hours. The major factors contributing to the difference between the reported average acceptable time to respond by phone and the actual time include two small West Coast electronics firms (both on contract) reporting minimum response time requirements of one and two hours, as compared to actual times received of 24 and 48 hours, respectively.

  - Large users reported an actual average MMTRt of 7.8 hours, as compared to an actual average time of 11.6 for users in the small category.

  - On-call respondents reported an actual average MTTRt of 8.4 hours, while their on-contract counterparts reported a figure of 11.0 hours. This difference in MMTRt as a function of contract status may possibly explain a portion of the higher degree of satisfaction reported by the on-call customers as compared to the on-contract respondents.

- During the 1983-1985 time period, users will continue to demand better response to their requests for service. The average acceptable 1983 mean time to respond by phone of 3.25 hours will decrease again to 3.1 hours by 1985, as shown in Exhibit V-10.

EXHIBIT V-9

MINIMUM ACCEPTABLE VERSUS
ACTUAL LEVELS FOR MTTRt
(MEAN TIME TO RESPOND BY TELEPHONE)

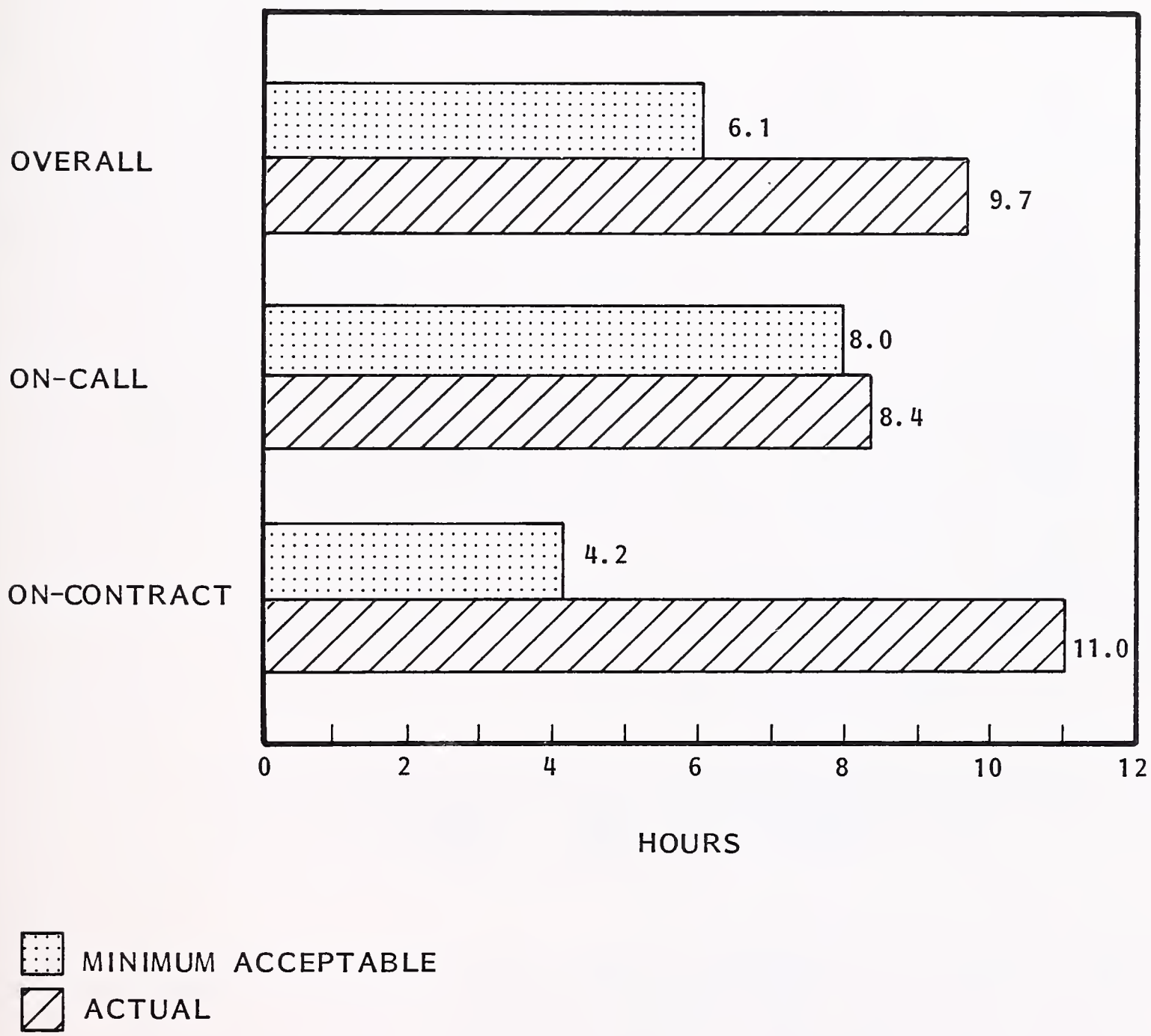
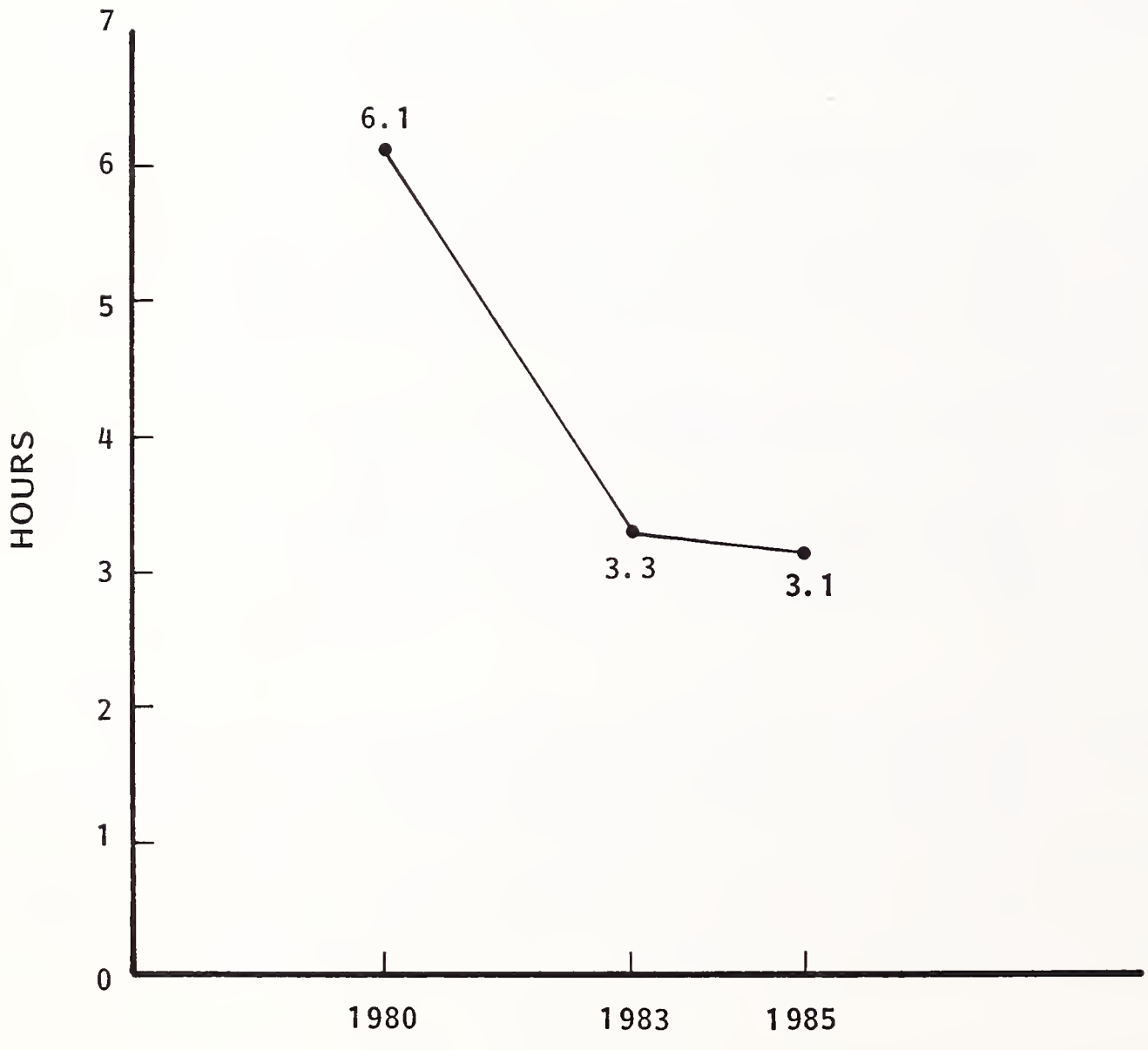


EXHIBIT V-10

PROJECTED TRENDS FOR
MTTRt, 1980-1985



INPU

- Respondents reported an average acceptable mean time to respond on site (MTTRs) of 14.2 hours, as shown in Exhibit V-11. This figure does not vary in any significant way as a function of either company size or contract status.

- Survey participants reported an actual MTTRs of 46.6 hours.

  - Large companies reported an average elapsed time of 56.8 hours between the time a service call was placed and the time the FE arrived on-site. Small companies' counterpart reported an actual MTTRs of 36.4 hours.

  - On-call customers reported a MTTRs of 54.5 hours, as compared to a MTTRs of 38.8 hours for customers in the on-contract category.

- By 1983, respondents will be requiring a MTTRs of 11.3 hours, with a further decrease to 10.6 hours by 1985, as shown in Exhibit V-12.

- In terms of actual time to repair once the FE has arrived on-site (MTTRs), the respondents report a minimum acceptable time of 14.3 hours and report actually receiving an average repair time of 22.1 hours, Exhibit V-13.

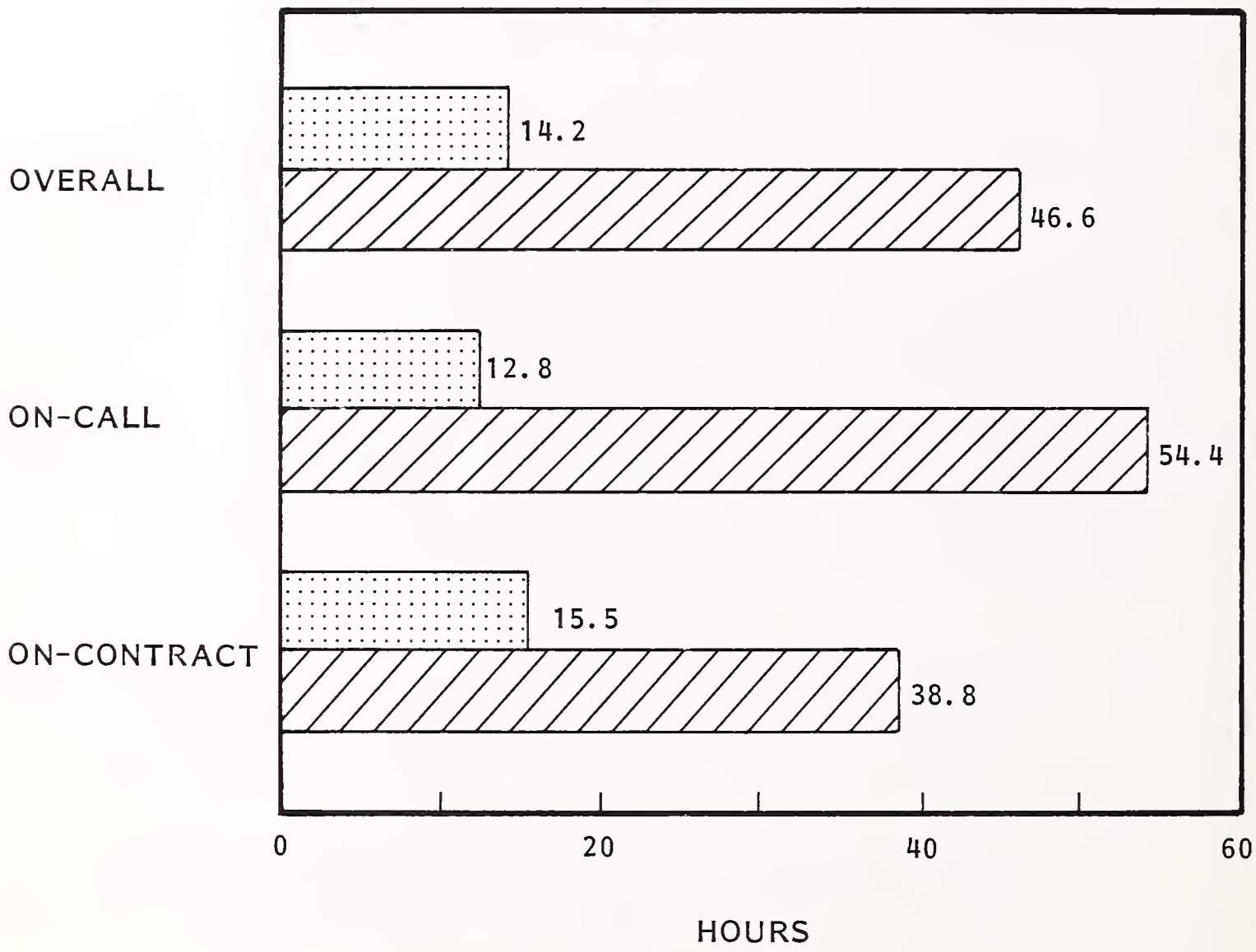
  - Large users are much more demanding about their minimum acceptable levels for repair time, with an average minimum acceptabie figure of 7.1 hours, as compared to 22.3 hours for small companies.

  - On-call customers reported a minimum acceptable repair time of 17 hours, as compared to a corresponding acceptable repair time of 11.3 hours for customers on contract.

- As with other performance measures, the minimum acceptable levels will become increasingly demanding during the next five years. By 1983 the minimum acceptable repair time will be ten hours, by 1985 it will decrease again to nine hours, as shown in Exhibit V-14.

EXHIBIT V-11

MINIMUM ACCEPTABLE VERSUS
ACTUAL LEVELS FOR MTTRs
(MEAN TIME TO RESPOND ON-SITE)



INPU

EXHIBIT V-12

PROJECTED TRENDS FOR
MTTRs, 1980-1985

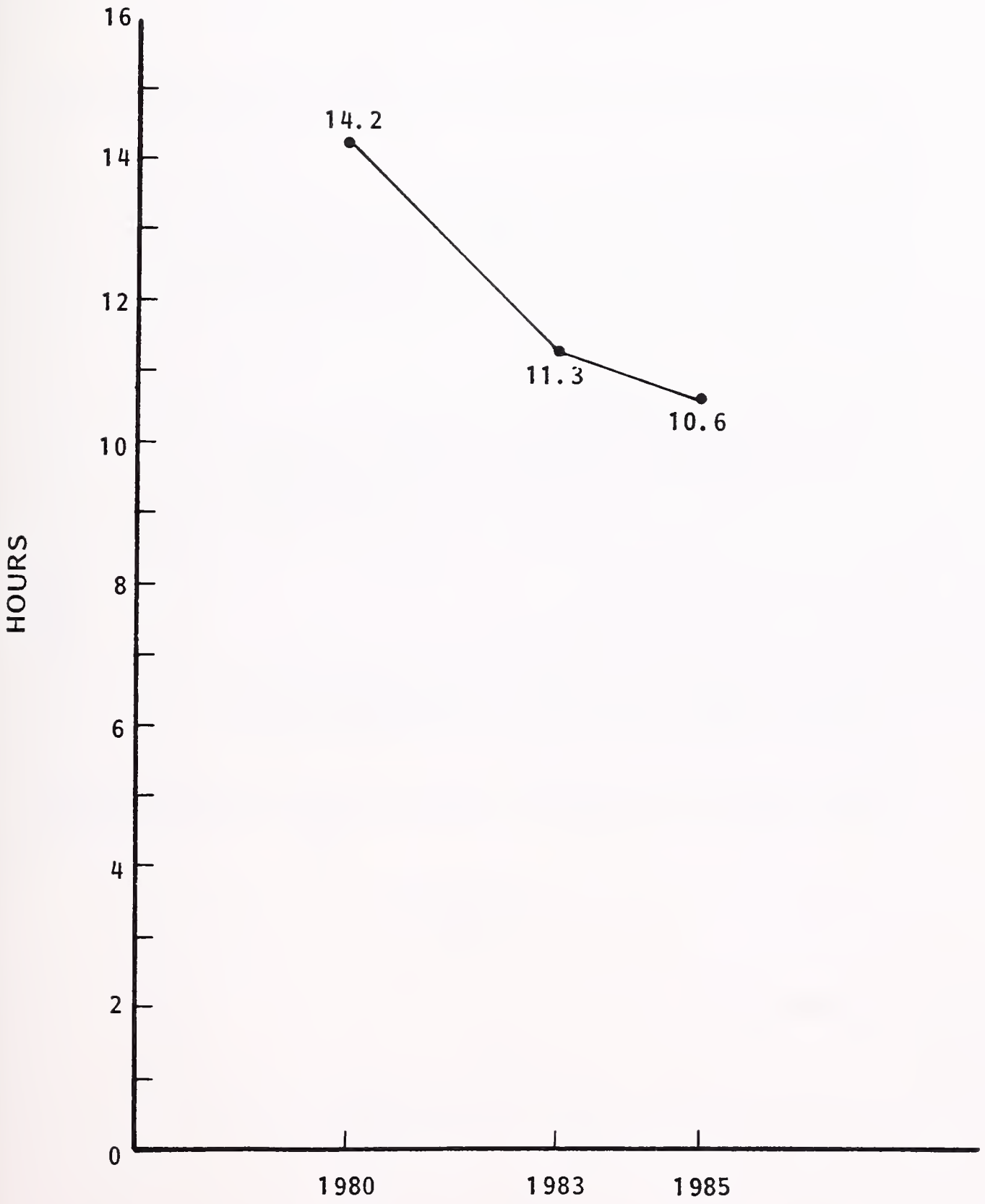
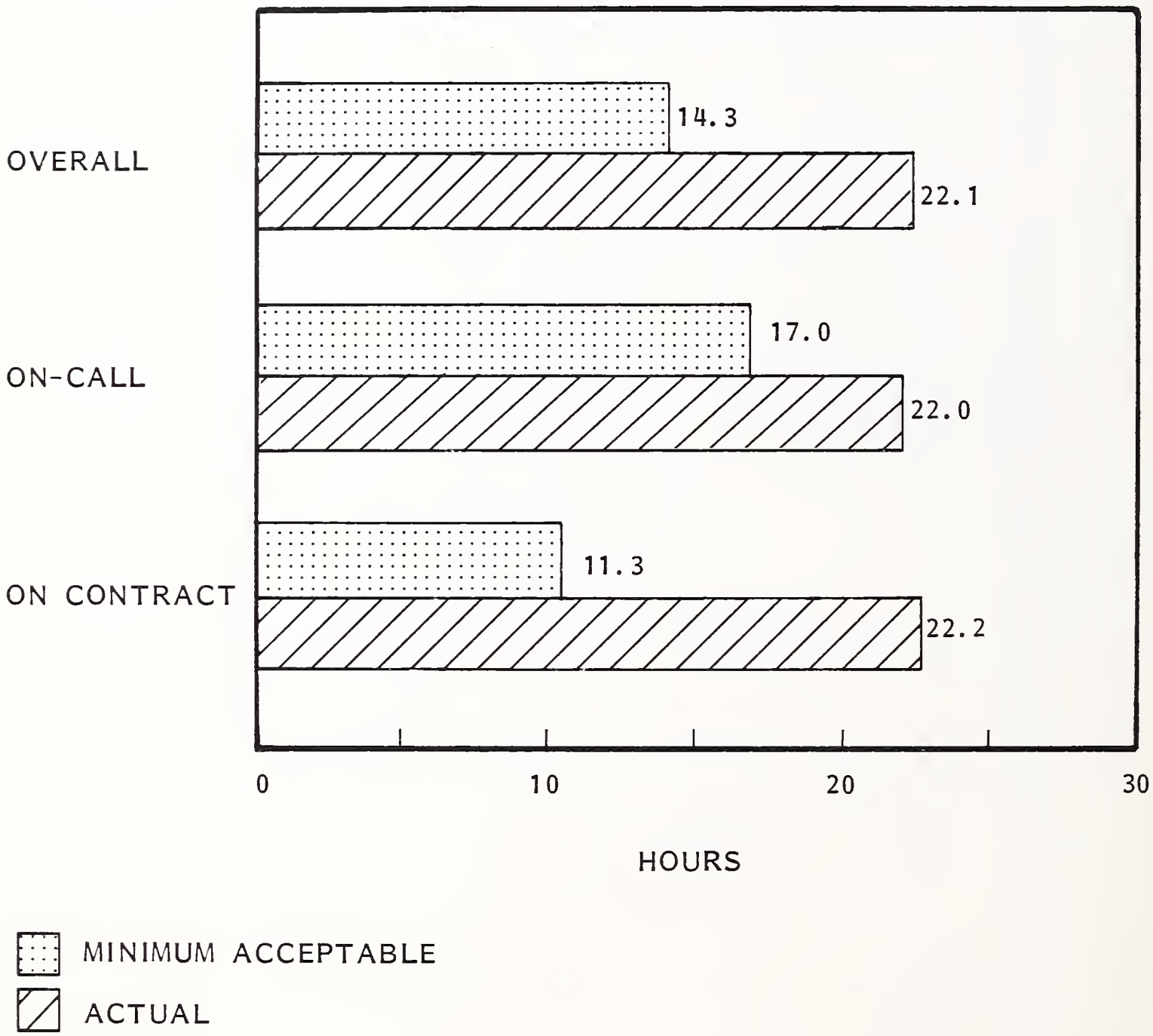


EXHIBIT V-13

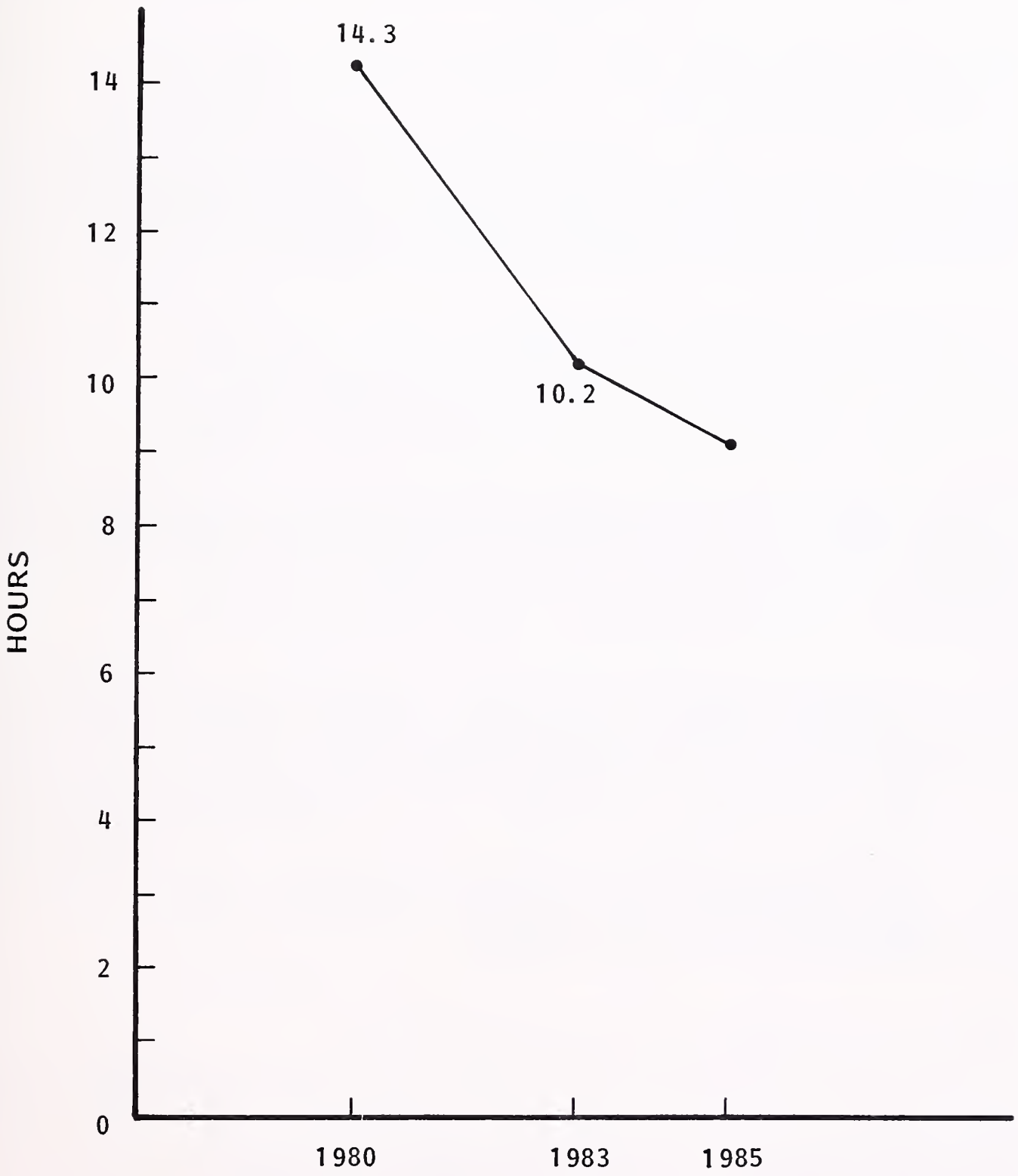
MINIMUM ACCEPTABLE VERSUS
ACTUAL LEVELS FOR MTTRr
(MEAN TIME TO REPAIR)



INPU

EXHIBIT V-14

PROJECTED TREND FOR
MTTRs, 1980-1985



- All users are very concerned about what they consider totally unacceptable time periods between the placement of the service call and the serviceperson's response. In many instances the users feel that the trouble may be fixed by user/FE conversations on the telephone, but they are all too frequently left "hanging" while they wait for a call from the FE. As one respondent put it:

  - "They're supposed to get back to me within one hour, but if I don't call back I'd be waiting here forever."

9. TYPES OF SERVICE CALLS

- Respondents report that an average of 18% of all the service calls they receive are repeat calls. They are distributed as follows:

  - On-call, 12%; on-contract, 23%.

  - Electronic applications, 20%; mechanical applications, 6%.

- The 20 survey respondents reported that on 41% of all service calls they receive, they have to wait for parts to arrive before the system can be repaired.

  - As could be expected, the on-call customers reported that a much lower percentage of their service calls resulted in waits for parts than did their on-contract counterparts (28% versus 55%). As on-contract customers do not have to pay for parts directly, the FE is apparently much more likely to use spare parts as diagnostic tools with them since much less justification is required.

10. 1980-1985 CHANGES IN FE SKILL REQUIREMENTS

- There was almost universal agreement among the survey participants that the FE of 1985 will have to be much more applications-oriented.

- The hypothesis stated in the 1985 scenario regarding stratification and redeployment of field engineering talents was soundly rejected by the 20 respondent users. It is the collective opinion of CALMA users that field service personnel must become more sophisticated in system problem-determination in the future.

11. RELATIONSHIP OF SALES AND SERVICE

- A large majority of the respondents (70%) reported that sales and service were organizationally separate and would continue to be so during the next five years. It is the collective opinion of the participants that this separation will be exaggerated by the rapid expansion of the CAD/CAM market, which will be holding the interests of the sales function. Some typical comments:

  - "Essentially, what is happening is that the sales department makes a sale and then says, 'So long.' They could care less once the sale is made."

  - "The service and sales functions have to be separate since the service department described to me by the marketing representative bears absolutely no relationship to the one I'm dealing with."

  - "They're separate. We have the OEM do most of the work on our CALMA system. We have a contract with our disk vendor." (On-call customer)

  - "It's very definitely separate. The best evidence of that is the fact that our maintenance is performed quite well by a third party." (On-call customer)

12. USER REACTION TO PROPOSED SCENARIO FOR FIELD SERVICE - 1985

- As set out below in Exhibit V-15, several of the elements of the proposed scenario of a maintenance organization of the 1980s were presented to

EXHIBIT V-15

CALMA USERS' EVALUATION OF
PROPOSED SCENARIO

ELEMENT	PROBABILITY	AVERAGE ACCEPTANCE (+)	AVERAGE REJECTION (-)	NET ACCEPTANCE/ REJECTION
ROUTINE MAINTENANCE PERFORMED BY USER	2.75	2.60	-2.10	+0.25
BOARD/UNIT REPLACE-MENT BY USER	2.50	2.80	-2.30	+0.25
REMOTE DIAGNOSTICS WITHOUT ON-SITE FE	3.30	4.00	0	+4.00
FE MORE APPLICATIONS-ORIENTED	2.75	3.95	0	+3.95
UNBUNDLED SERVICE CONTRACTS	2.90	2.67	-2.50	+2.65
USER LEASE/PURCHASE OF SPARES	2.10	2.75	-3.50	-1.00
ORGANIZATIONAL SEPA-RATION OF SALES AND SERVICE	2.75	2.57	-2.67	+1.00
SERVICE COST ABOVE 15% OF SYSTEM COST PER YEAR	2.45	0	-3.35	-3.35
EXTRA CHARGES FOR SITES BEYOND A 75 MILE RADIUS OF A FE LOCATION	3.25	0	-3.20	-3.20
SYSTEM SUPPORT CENTER	3.70	4.65	0	+4.65

(PROBABILITY: 1 = VERY UNLIKELY, 5 = VERY LIKELY. ACCEPTANCE: 0 = NEUTRAL, +1 = SOMEWHAT ACCEPTABLE, +5 = VERY ACCEPTABLE, -1 = SOMEWHAT UNACCEPTABLE, -5 = VERY UNACCEPTABLE)

respondent users. They were asked to comment on the probability of each element of the scenario as well as their evaluation of the activity's positive or negative influence on the quality of maintenance received.

- The probability that each element would become standard procedure by 1985 was measured on a 1-5 scale, with 1 indicating very unlikely and 5 indicating very likely. Their acceptance of the particular elements was assessed on a 10-point scale, with 0 indicating a neutral attitude, and positive or negative values from 1 to 5 indicating the degree of acceptance or nonacceptance.

- As shown in Exhibit V-16, respondents believe that system support centers are fairly likely to be common practice for service organizations by 1985. System support centers are also considered very acceptable to users.

  - User lease/purchase of spares is seen as the least likely event.

  - Respondents view a more applications-oriented FE as a highly acceptable trend for service organizations, but they do not feel that this is likely to become standard practice by 1985.

13. CENTRALIZATION OF CAD/CAM AND EDP

- The majority of respondents (65%) do not foresee the centralization of CAD/CAM within the EDP department within the next five years.

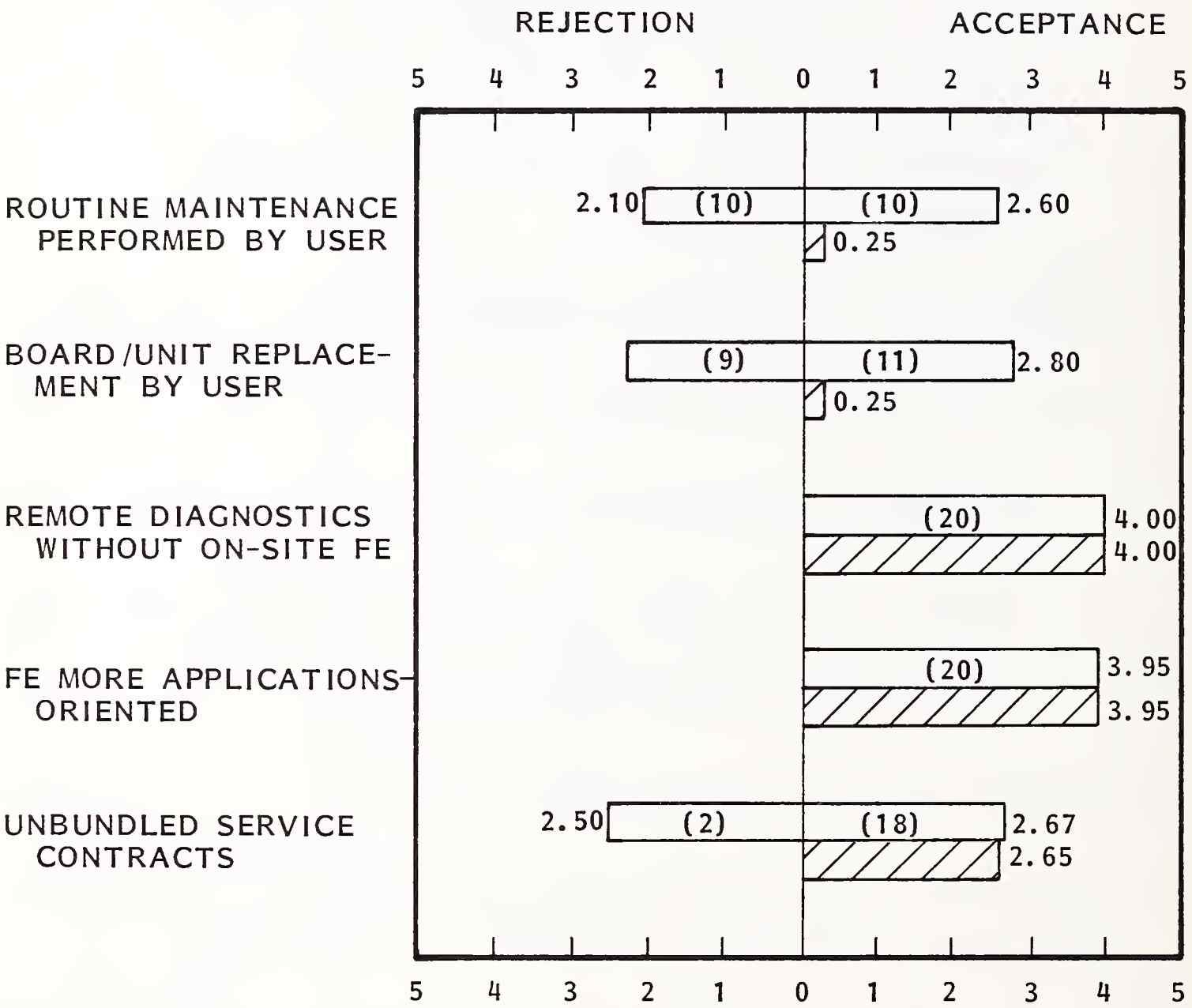
  - A large majority of the small users (90%) see no trend towards centralization of CAD/CAM within the next five years.

  - A majority (60%) of the large users do, however, see a trend toward centralization of CAD/CAM under either the EDP manager or MIS Director within the next five years. This issue is perceived, in part, as the result of an increasing need to off-load a good portion of the calculation requirements from CAD/CAM systems onto larger main-

EXHIBIT V-16

CALMA USERS' EVALUATION OF

1985 SERVICES SCENARIO



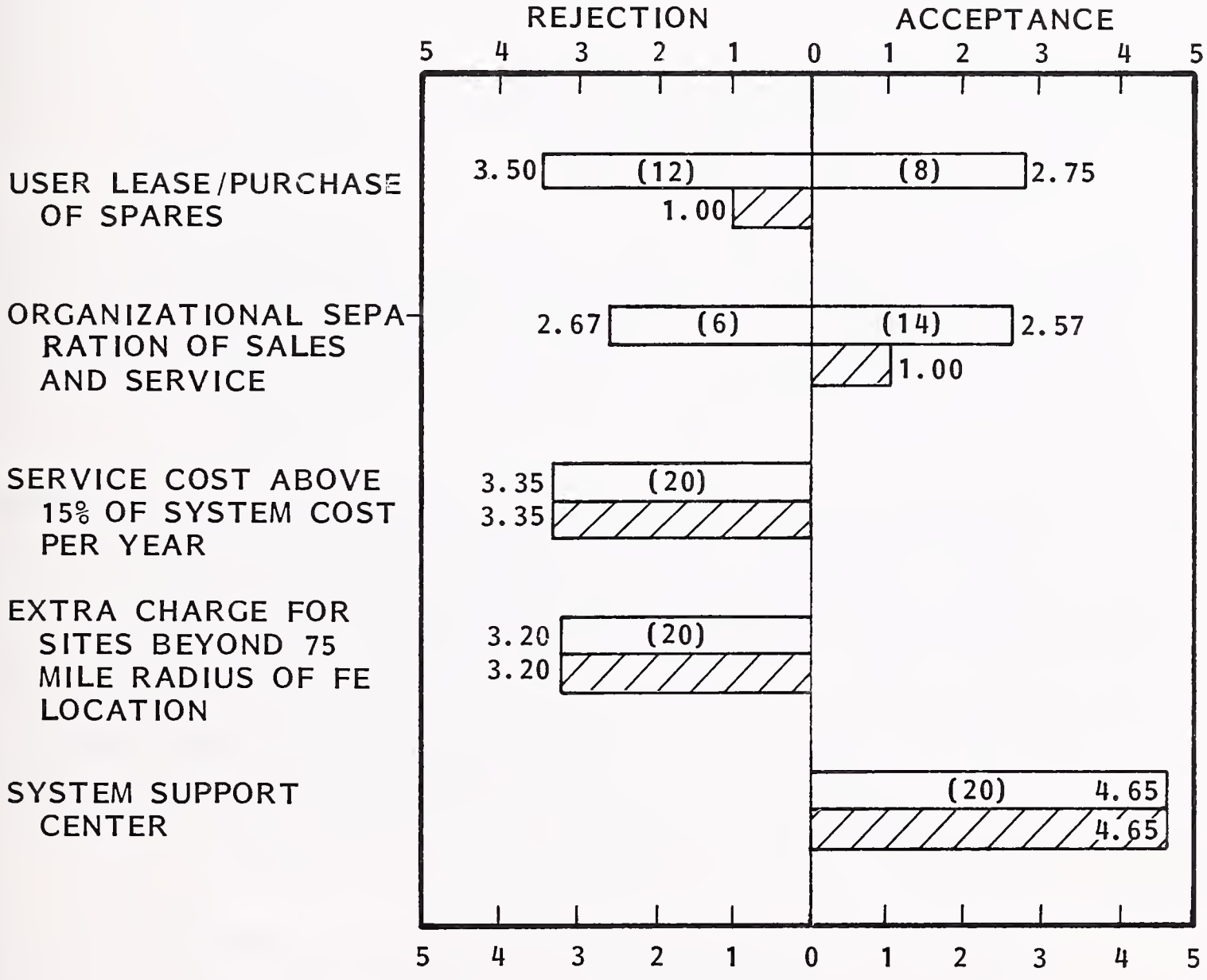
AVERAGE ACCEPTANCE/REJECTION

NET EFFECT

INP

EXHIBIT V-16 (CONT.)

CALMA USER'S EVALUATION OF
1985 SERVICES SCENARIO



AVERAGE ACCEPTANCE/REJECTION

NET EFFECT

frames, which falls under the responsibility of either the MIS Director or EDP manager.

- While large users recognize the need for more communications with a host computer, they are reluctant to relinquish control of their systems, citing a lack of understanding of their application needs by the EDP department.

14. COMBINED VERSUS SEPARATE SOURCES FOR HARDWARE AND SOFTWARE MAINTENANCE

- The majority of respondents (15 of 20) feel that there should be only one source for all maintenance. They stress the fact that a CAD/CAM system is only artificially separated into hardware and software components, since it is essentially one system.

  - The respondents reported that it is unlikely that one individual can be equally proficient in both hardware and software elements of the system, and thus either the hardware or software element must be made sufficiently simple and reliable to allow maintenance to be performed by an individual relatively unskilled in the second element. In other words, they feel that the hardware portion of the maintenance activity must be made skill-independent, thereby allowing the responding FE to be more applications-oriented.

  - Users report a good deal of frustration with the artificial distinction between hardware and software. They feel that the unprofessional attitudes of the FEs will result in "finger-pointing." They want the system fixed, not an explanation of whether the fault is hardware or software in nature.

- The 15 respondents indicating a preference for combined sources of maintenance are evenly split according to their opinion of the type of individual who should be in charge of such an organization. Eight of the respondents

preferred an individual with a service-related background while seven preferred an individual with a background in sales with aftermarket responsibilities. A discrete sales background was completely ruled out as inappropriate background for an individual in charge of a maintenance organization.

15. USER DESCRIPTION OF A SUPERIOR SERVICE ORGANIZATION

- The following are those requirements which respondents feel are necessary if an organization in today's market wishes to be considered superior:

  - A parts distribution system that would allow for parts arrival within eight hours of request.

  - Complete systems knowledge among the FE staff.

  - A system support center in operation a minimum of two shifts per day.

  - A sufficiently large FE staff to be able to meet peak demands with a minimum of delay in response time.

- By 1983, the list is enlarged to include:

  - Twenty-four-hour hotline for hardware and software.

  - Remote diagnostics with an on-site FE.

- By 1985:

  - Remote on-line diagnostics.

  - Sufficient flexibility to be able to meet state-of-the-art requirements within a minimum time.

- Users feel that the present level of service they are receiving is barely meeting what they consider to be their basic needs. They are not sure if CALMA will be able to meet their maintenance needs within the next few years. They are considering options such as contracting with the original equipment manufacturers of the different systems components as a way to counteract what they feel is a definite lack of systems knowledge on the part of CALMA FEs.

16. IMPORTANCE OF SERVICE IN CAD/CAM PURCHASE DECISIONS

- The respondents indicated that, in the overall decision to purchase a CAD/CAM system, the quality of field service would amount to 34% of the total decision as to which system to purchase.

  - This figure is complicated by the fact that for many of the users, the system now in place was their initial purchase and thus the field service capabilities of the vendor were unknown. They now state that their decisions in the future will not be as naive as their initial decision, and they will be requiring much firmer commitments to a particular level of maintenance than was the case in the initial purchase decision.

  - While the quality of field service is now considerably more important in the purchase decision, it is not seen as a sufficient reason for excluding a particular vendor from future systems purchases. The indication is that they can always approach the OEM for maintenance if the vendor is not capable of providing the proper level of maintenance.

  - Several respondents stated that they have been hearing a lot of talk about the attempts by CALMA to address the problems they are presently facing in the area of field maintenance. They are willing to allow for a certain length of time to pass before deciding on the source of their future maintenance. The most commonly reported length of time mentioned was the amount of time left on their present contract.

17. PROCESS CONTROL AS AN EXTENSION OF CAM

- Seventeen out of the 20 respondents indicated that process control was very much a logical extension of CAM. It was the general opinion of those surveyed that present applications for CAD/CAM systems were just the tip of the iceberg and that the next five years would see CAD/CAM encroaching on all areas of manufacturing.

18. VENDORS CONTACTING SURVEY RESPONDENTS

- The following are vendors that have reportedly been in contact with the respondents during the last six months regarding their future CAD/CAM needs.

  - CALMA - ten mentions.
  - Applicon - nine mentions.
  - Houston Instruments - one mention.
  - Xynetics - one mention.
  - Computervision - six mentions.
  - United Telecommunications - one mention.
  - Cal-Comp - two mentions.
  - Gerber - three mentions.
  - Redac - one mention.
  - Carr - one mention.
  - SCI-CARDS - one mention.

- Bell Northern - one mention.

- Mark Revel - one mention.

- Each respondent was asked specifically if CALMA had been in contact with them during the last six months concerning their future CAD/CAM needs. As shown, only half of the respondents indicated that this was the case.

19. IMPACT OF LARGE VENDOR ENTRY INTO CAD/CAM

- The majority of respondents (12 of 20) indicated that CALMA would be adversely affected if a large vendor were to enter the market. That entry is not considered very likely within the next two years, indicating that if such an entry does not take place before then, companies such as CALMA and Computervision would be more than able to hold their own.

- CAD/CAM is regarded as sufficiently unique to not automatically guarantee successful entry by a vendor of any size.

20. ABILITY OF PRESENT SYSTEMS TO MEET REQUIREMENTS OF VLSI TECHNOLOGY

- Users within the electronics segment universally agree that no system from any vendor presently meets the requirements forecasted for VLSI technology. The most frequently mentioned limitations were speed, memory and throughput. Respondents feel that future developments in CAD/CAM will come from systems that are not standalone and that do not perform the entire design cycle.

C. COLLECTED COMMENTS

- "We did a cost/benefit analysis and we can show it's more economical not to have a contract."

- "CALMA is not meeting our service demands and it has been getting worse ever since they were acquired by United Telecommunications."

- "We have a lot of reliability data in our library. The equipment is becoming increasingly reliable, which is softening the impact of bad service."

- "If an IBM or a DEC were to come into the market, we would be forced to look at them, given their history of quality."

- "The feeling fom the 'top' is that the benefits of having a service contract are just not justified by the cost."

- "CALMA is meeting our present needs but it's due to equipment reliability rather than FE department performance. They take far too long to get here because we have last priority since we don't have a contract."

- "I don't think any of the present CAD/CAM vendors will be able to meet the requirements of excellence in service by 1983 if they intend to grow as much as they think."

- "Our present system (GDSII) just can't handle the requirements of VLSI. It just takes too much of the 'rock.' We're looking at a VAX or a Harris to download the big jobs to. Our system is going to be a peripheral, basically."

- "CAD and EDP are separate now due to political considerations. Future configurations will require centralization."

- "At their present rate of growth and hire rate they will not be able to meet the service requirements of 1983. They must increase their FE staff dramatically and train them in a systems context."

- "If an IBM or DEC came in of course a CALMA would be negatively affected from both a price standpoint as well as service coverage. We would have more confidence in the system and we could also expect a lot more R&D activity."

- "Our biggest consideration in a purchase decision is throughput time reliability. Next comes quality of service as it impacts equipment reliability."

- "If a big vendor entered the market it would hurt Computervision and Applicon a lot more than it would CALMA."

- "I would definitely look at any system put out by IBM. They have the reputation for quality and service. They can also develop seven systems and pick the best one for release. The turnkey vendors put it all on one system."

- "The more competition in the field, the better I like it. You get better products and service that way."

- "We're going to demand some price concessions from CALMA if they expect us to renew our contract."

- "If a big vendor were to enter the market it would probably severely limit the rate of growth for all turnkey vendors. It could also be the best thing that could happen to them in the next few years. They could concentrate on developing their system without drooling over all the money that's supposed to be out there."

- "I would never use their maintenance again, but their system is the best around for the IC applications."

- "Software controls hardware. The best tech in the world can't help if he doesn't know software."

- "We funded for a service contract when we got the CALMA system, but the equipment was so reliable during the warranty period we decided it wouldn't be cost effective to get the contract."

- "CAD is CAD. Computer skills do not transfer directly; Tektronix found that out when they fell on their face with their CAD system. What CALMA has to

worry about is if a DEC or Hewlett-Packard or even IBM bought a company like Applicon."

- "CALMA could compete right now with a big vendor entry. They're owned by a pretty big conglomerate themselves."

- "We're removing all peripherals from CALMA service and contracting with the OEM. It's more efficient that way and cheaper too. The fact that it's cheaper really surprises me, I always thought a package deal would be cheaper."

- "Sales and production get all the priorities at CALMA. It's too bad but they're really getting a bad reputation for lousy service. If they don't turn it around soon, we'll have to go to a third party for our maintenance needs."

- "CAD is really a specialized area and mere DP knowledge doesn't mean you'll make a good CAD system. We tried and failed. It cost us about two years."

VI COMPETITOR ANALYSIS

VI COMPETITOR ANALYSIS

A. METHODOLOGY AND PURPOSE

- On-site interviews were conducted with 10 executives of six present and potential competitors. (See Appendix D for questionnaire.)
  - M & S Computing, Inc.
  - Computervision Corporation.
  - Applicon Incorporated.
  - Gerber Systems Technology, Inc.
  - Control Data Corporation.
  - Tektronix, Inc.
- Titles of individuals interviewed ranged from manager to vice president.
- Functional responsibilities of respondents included:
  - Sales.

- Strategic Planning.

- Customer Service (Total).

- Field Service (Hardware).

- Public Relations.

- Product Planning.

- Exhibit VI-1 shows the purpose of on-site competitive interviews, which was to test the probability of hypotheses asserted during phase one of the study, and to discover other significant trends in CAD/CAM affecting CALMA's ability to field a superior maintenance organization for the 1980-1985 timeframe.

  - Trends in user performance of routine maintenance.

  - Competition attitudes toward stratification and redeployment of FE talents.

  - Indicated trends toward internally designed unit testers and exercisers.

  - Remote diagnostics development.

  - Discrete level of site hardware maintenance:

    . Module.

    . Unit.

    . Board.

    . Component.

EXHIBIT VI-1

SCENARIO - 1985

- ROUTINE MAINTENANCE PERFORMED BY END USERS
- MORE STRATIFICATION OF FIELD ORGANIZATIONS WITH REDEPLOYMENT OF TALENTS
- TEST ROUTINES MICROPROGRAMMED INTO UNITS AND BROUGHT TO PANELS AND PLUGS
- REMOTE DIAGNOSTICS FULLY IMPLEMENTED TO CPU, SOME DOWN-LINE LOADING TO PERIPHERALS
- FIELD MAINTENANCE LIMITED TO BOARD AND MODULE REPLACEMENTS IN NEWER EQUIPMENT
- F.E. WILL BECOME MORE APPLICATIONS-ORIENTED
- ANALYZERS AND SIGNATURE ANALYSIS-TYPE TESTERS FLEXIBLE ENOUGH TO RUN ON COMMON TESTER INTERFACE PLUGS
- TRADE SCHOOLS WILL PROVIDE MOST RAW RECRUITS
- F.E. ORGANIZATIONS TO BE CASH-GENERATING DIVISIONS
- PRICE SENSITIVITY WILL FORCE F.E. MANAGEMENT INTO COST/BENEFIT ANALYSIS IN PROPOSALS

- Trends in skills level of field engineers in applications and systems.
- Test equipment requirements.
- Recruiting sources.
- Maintenance price sensitivity.
- Field Service organizational structures.
- Attributes of a superior field service organization by 1985.
- Product characteristics of future CAD/CAM systems.

- As a group, competitors are diversified and serve all major industries with applications competitive to CALMA in all respects.
  - Mapping specialization.
  - Manufacturing and tool design specialization.
  - Electronics specialization.
  - Diversified competition.

B. CAD/CAM GROWTH PROJECTIONS

- Without exception, competitors expect CAD/CAM applications to continue to grow at a compounded rate exceeding 50% over the next five years.
- Half of the competitors projected growth rates of 25-50% over the next five years, the other half reported that their growth rates would exceed 50%.

- One competitor felt that present CAD/CAM turnkey vendors would maintain growth rates approaching 50% for two years, but would lose out to superior competition by 1983 and drop to below 25% for the ensuing years.

- All other competitors acknowledge that "most" present turnkey vendors will experience an erosion of market share after 1983, but only one admitted that the erosion in their case would fall to below the 25% growth rate.

- Two competitors asserted that the key to maintaining and improving market share was in more intensified specialization, not diversification; others were silent on strategy.

- Competitors aware of federal grants to develop CAD software for the public domain expressed no great concern.

  - One competitor stated that their R&D directions would be shifted toward integration of "public domain" benefits.

  - Two competitors stated that federal research grants had no visible effect on their specializations.

  - Others had no comments regarding federal funding of CAD research and development.

- All competitors agreed that the two major growth areas in CAD/CAM would be in mechanical design and electronic design applications.

  - A two-to-one ratio of competitors forecasted greater growth for stand-alone turnkey workstations in mechanical design applications over electronic.

  - A comparable 65% predicted that growth in electronics applications would be greater than mechanical for intelligent workstations communicating with large host systems.

C. COMPETITORS FE ORGANIZATIONAL STRUCTURES

- Half of the competitors predicted that by 1983 the FE organization would be a division reporting to the company president, as noted in Exhibit VI-2.
  - Only one competitor FE organization currently reports to the president.
  - Two report to the centralized CAD/CAM marketing/sales organizations.
  - One reports to the General Manager of the Systems Division which includes all of CAD/CAM, among other systems.
  - One reports to the VP of Engineering.
  - One reports to VP of Engineering Services.
  - All competitor FE organizations report to a function which assures centralized service for all of the CAD/CAM effort.
- Five of the six competitors expect field engineering to be a separate P&L function by 1985.
  - Half the FE organizations are currently measured by P&L.
  - Organizations changing from cost centers to profit centers by 1985 are not firm in their predictions of changes by 1983.

D. COMPETITOR PERSONNEL ISSUES

- Competitors currently rank other competition second to the armed forces as a recruiting source for field engineers, as shown in Exhibit VI-3.

EXHIBIT VI-2

COMPETITOR FE ORGANIZATIONS

COMPANY FE ORGANIZATION	REPORTING TO		
	1980	1983	1985
COMPANY A	PRESIDENT	PRESIDENT	PRESIDENT
COMPANY B	SALES VICE PRESIDENT	PRESIDENT	PRESIDENT
COMPANY C	MARKETING VICE PRESIDENT	MARKETING VICE PRESIDENT	MARKETING VICE PRESIDENT
COMPANY D	GENERAL MANAGER SYSTEMS DIVISION	GENERAL MANAGER SYSTEMS DIVISION	GENERAL MANAGER SYSTEMS DIVISION
COMPANY E	VICE PRESIDENT ENGINEERING	PRESIDENT	PRESIDENT
COMPANY F	VICE PRESIDENT ENGINEERING SERVICES	VICE PRESIDENT ENGINEERING SERVICES	VICE PRESIDENT ENGINEERING SERVICES

EXHIBIT VI-3

COMPETITOR RECRUITING SOURCES

SOURCES FOR FE PERSONNEL	RANKED PREFERENCE		
	1980	1983	1985
TRADE SCHOOLS	2.6	3.3	4.0
COMPETITION	3.8	4.0	4.3
ARMED FORCES	4.8	4.1	3.0
2-YEAR COLLEGE	1.3	2.0	2.7
4-YEAR COLLEGE	1.0	1.5	2.3
NO TRAINING	1.0	1.0	1.0

SCALE = 1-5, WHERE 1 = MINOR IMPORTANCE AND 5 = MAJOR IMPORTANCE.
RESPONSES = 10

- CALMA's competitors, recognizing the growing shortage of qualified personnel, predict that their competition will become the major source of recruits by 1985.

- Competitors will look more toward trade schools to provide qualified entry-level personnel by 1985.

- A slight increase in college recruiting will be noticeable by 1985, further recognition of the need for increased awareness in applications of CAD/CAM.

- Competitors continue to reject the idea of training new personnel in fundamental skills.

- Competitors rejected the idea that less qualified personnel would be dispatched to site maintenance in CAD/CAM. Every person interviewed said that their company will run counter to the DP industry trend to hire lower qualified personnel and redeploy talents.

- Every competitor responded that all FEs must become more applications-oriented by 1985.

  - Most respondents modified the term "applications-oriented" to "systems-oriented."

  - All respondent competitors explained that systems and/or applications orientation in CAD/CAM did not necessarily include an internal knowledge of software, but a grasp of the objectives of various software modules.

E. COMPETITOR TECHNICAL OPERATIONS ISSUES

- Every competitor will base support planning on the expectation that virtually all future devices will incorporate internal tests and exercizers accessible by common interface plugs and panels.

- All competitors are working on remote diagnostics for CAD/CAM.

  - All but one of the competitors anticipate the implementation of a minimum capability in remote diagnostics by 1983.

  - Most competitors are limited in their abilities to implement full-scale remote diagnostics by 1985.

    . Turnkey systems are limited by unit capabilities.

    . Downloading of diagnostics to CPU and/or units is dependent on OEM interface.

- Only two respondents specified portable test equipment not currently available in the field that should be needed by 1985.

  - One respondent referred to "smarter scopes," meaning scopes with microprocessors built-in to perform analysis.

  - A second respondent would like to see more communications line testing devices available to the field in CAD/CAM.

  - The remaining competitors responded that less portable test equipment should be required and that present oscilloscopes are fast enough for 1985 requirements.

- All respondent competitors agreed that support level field engineers will require additional skills in the use of more sophisticated test devices, such as logic analyzers, by 1985.

- The subject of total maintenance service to CAD/CAM users by 1985 becomes a unanimous opinion by respondents.

  - All competitors expressed the belief that by 1985 all hardware maintenance, software maintenance and after-market image control should be integrated into a centralized function.

  - The transition from totally separate functions controlling customer service in 1980 to an integrated function in 1985 takes on various forms among the competitors.

    . Current customer satisfaction responsibilities and controls are evenly divided into three groups:

      - Separate responsibilities for hardware and software maintenance with no coordinating responsibility for either function.

      - Separate functions with field engineering coordinating efforts to resolution.

      - Separate functions with field engineering controlling efforts to resolution.

    . Respondents predicted that by 1983 the separate, uncoordinated maintenance functions will give way to FE control over the resolution of all customer problems.

- Only one of the respondent competitors has no formal procedure in place to escalate unresolved customer problems to the attention of higher management and support organizations.

  - All respondents, including the one without a formal procedure, are evaluating centralized dispatch as a control point to assure the escalation of outstanding problems.

  - Most escalation procedures begin with a two- to four-hour alert from the on-site FE that the equipment is still down.

  - The most common FE on-site response time objective is eight hours, but one competitor guarantees a two-hour on-site response.

- None of the CAD/CAM turnkey vendors expressed any interest in using or providing third-party maintenance.

  - Only one large vendor considers third-party maintenance to offer potential for additional profit.

  - All competitors desire complete control of their own maintenance problems.

F. BUSINESS POSTURE OF COMPETITOR FE ORGANIZATIONS

- The average cost of maintenance for respondent competitors is currently 10.2% of the purchase price of turnkey equipment.

  - The projected ratio of maintenance price to equipment purchase price will increase to 12.3% in 1983 and to 13.5% by 1985.

  - Respondents predicted that labor costs and transportation costs will continue to increase more rapidly than efficiencies from modern techniques of maintenance.

  - Two respondents replied that the current lower ratios of maintenance prices are distorted by inflated hardware prices burdened with software development costs. Both plan to unbundle software costs from product pricing within the next year.

- All respondents reported over 90% of their users were on maintenance contracts.

  - Only one competitor has software maintenance bundled into the FE maintenance contract, but the FE is not accountable for software maintenance or the associated expenses.

  - One competitor accounts for software maintenance expense as overhead.

  - More than half the respondent competitors have maintenance contracts signed at the time of the equipment sale but defer implementation until expiration of the warranty period.

- Each of the major components of hardware maintenance services is expected to be unbundled by at least one of the respondent competitors by 1985, as shown in Exhibit VI-4.

  - The most popular components for unbundling are:

    - Initial problem diagnosis by user.

    - Delivery of units to repair depots.

    - User purchase or lease of spare parts.

EXHIBIT VI-4

NUMBER OF COMPETITORS UNBUNDLING
MAINTENANCE SERVICES

COMPONENT	1980	1983	1985
USER DIAGNOSIS	0	2	3
USER INSTALLATION	0	0	1
USER REPAIRS	0	1	1
REGIONAL REPAIR DEPOTS	0	2	3
SELL OR LEASE PARTS	1	2	3
EXCLUDE PREVENTIVE MAINTENANCE	1	1	1
VARIABLE RESPONSE TIME	0	0	1

N = NUMBER OF AFFIRMATIVE RESPONSES
TOTAL SAMPLE = 6 COMPANIES

- No single component will be unbundled by more than half the respondent competitors.

- Competitors reported that nearly one-third (32.5%) of routine site maintenance will be performed by users before the end of 1985.

  - Initial problem determination.

  - First run of diagnostics.

  - Exchanging of units and modules.

  - Packaging and delivery of units and modules to repair depots.

- All competitors said that innovative ways must be found to offset labor and transportation costs before maintenance prices become prohibitive.

- All turnkey CAD/CAM competitors reported that the gross value of spare parts inventories averages about 50% of the annual maintenance revenues.

  - The lowest reported average was 45%.

  - Respondents reported no expected changes in the ratio of investment in spares to maintenance revenues over the next five years.

  - Projections included the value of any accessible spares purchased by users.

  - Most spare parts (70%) are kept at headquarters or consigned to field engineers, as shown in Exhibit VI-5.

- Half of the respondent competitors reported that they expect to see an increased requirement over the next five years for field engineering management to sell maintenance services by cost/benefit analysis.

EXHIBIT VI-5

DISTRIBUTION OF CAD/CAM
SPARE PARTS INVENTORIES

LOCATION	PERCENT OF INVENTORY
HEADQUARTERS	41%
REGIONAL DEPOT	11
DISTRICT/BRANCH OFFICE	18
FIELD ENGINEER (PORTABLE)	29
IN TRANSIT	1
TOTAL	100%

G. FUTURE PRODUCT CHARACTERISTICS AS REPORTED BY COMPETITORS

- Competitors generally agreed that CAD/CAM will incorporate much more distributed processing with multiple workstations in the near future.

  - Sharing mass storage.

  - Offloading extensive computations.

  - Increasing efficiencies and cost/performance per workstation.

- MIS directors will play an increasingly significant role in CAD/CAM purchasing decisions, according to the respondent competitors.

- "A proliferation of CAD/CAM service bureaus, complete with design engineers, is likely before 1985," said one competitor.

- Another competitor commented, "The product will continue to be an intangible benefit to designers; that is, a complete package they can't duplicate anywhere else."

H. COMPETITOR PERCEPTIONS OF A SUPERIOR FIELD SERVICE ORGANIZATION IN 1985

- When asked to comment on the significant attributes that should be possessed by superior CAD/CAM service organizations, vendors replied:

  - "They had better be more responsive, especially in multiple workstation environments."

- "Mean Time To Repair must improve significantly over today's standards."

- "Future CAD/CAM FEs need to act rather than react."

- "FEs must consider themselves an integral part of the marketing function."

- "FEs must be more systems-oriented."

- "FE departments need more businessmen in management."

- "A superior organization will be responsive to the users' needs rather than insisting on doing things by the book."

APPENDIX A: DEFINITIONS

APPENDIX A: DEFINITIONS

APPLICATIONS-ORIENTED Describes a field engineer who is able to relate to the ultimate user of a system in terms of the application to which it is applied. The term is sometimes misused to connote a knowledge of applications software.

"BUNDLING" The practice of including all benefits under the umbrella of one price.

BURN-IN A product test and quality control procedure which creates environmental conditions beyond specified limits for the purpose of causing marginal components to fail. Although the term is generally used to denote testing under heat, it is used by some engineers to connote any environmental stess test which accelerates the life of components.

"FRIENDLY" Industry jargon giving human characteristics to components of computers, meaning that the human engineering function has succeeded in creating methods of interface requiring little or no machine or programming knowledge.

INFANT MORTALITY Descriptive term used by engineering to separate normal, random failure of components from failure caused by defective components not detected by quality control methods. Usually the failures occur during the warrranty period or during a second "burn-in" phase.

LOGIC ANALYZER A test device capable of storing digital representation of multiple channels of oscilloscope patterns and restoring historical events to the oscilloscope screen on command.

MAINTAINABILITY DESIGN The designing of features into equipment to reduce time and effort required to maintain the equipment; e.g., diagnostic aids, access panels for components, removable components, test plugs and panels, etc.

MBO Management By Objectives, a method of planning and controlling functional goals and performance.

MTBF Mean Time Between Failure for a system.

$MTTR_r$ Mean Time To Repair a problem and restore the system to use.

$MTTR_s$ Mean Time To Respond on Site to a service call.

$MTTR_t$ Mean Time To Respond by Telephone to a service call.

OVERLOAD Jargon used by engineers to express a critical management situation by analogy to an electrical circuit which, when "overloaded", will burn out if not protected by a fuse or a circuit-breaker.

PRESENT VALUE ANALYSIS A financial analysis technique used to equate future cash flows or other benefits to the equivalent present value that would be required at a predetermined interest rate to produce the same stream of benefit or costs. The implicit assumption is that money has time value.

RELIABILITY The probability that a system or component will operate for a specified mission or segment of time without failure, expressed as a percent between zero and 100%. By convention, without a statement of all parameters, a computer with a reliability of 95% would indicate a probability of failure during any one day of operation of only 5%.

REMOTE DIAGNOSTICS A term used to describe any diagnostic effort performed off-site. Modern usage tends to restrict the term to applications involving a telecommunications interface between a remote diagnostician (FE specialist) with a terminal and at least a limited ability to view the output of diagnostics running on the equipment.

SHOTGUN Field engineering jargon describing a diagnostic method that replaces several components at a time to see if the trouble disappears. A term generally considered derisive by experienced field engineers.

SIGNATURE ANALYSIS A testing method using a device that exercises electronic circuits with predetermined patterns of input, expecting specific output patterns (the signature). Deviations from expected results are analyzed by the device and point to probable failing components.

SYSTEM SUPPORT CENTERS The term is currently used to describe centers to which users call with software problems and questions. The term is also used to describe centers for remote telephone assistance to field engineers on-site.

SYSTEMS-ORIENTED Describes a field engineer who understands the interaction and complexity of all units comprising a system as well as the combined benefit of the interaction (as opposed to a field engineer who understands only the discrete units of a system, but not the overall system effect).

UNBUNDLING Breaking down a previously bundled pricing structure into individual components of service, with options and prices for each benefit.

APPENDIX B: VENDORS INTERVIEWED

APPENDIX B: VENDORS INTERVIEWED

- Comma (CDC)
- Fairchild
- Genisco
- Hazeltine
- Hewlett-Packard
- Indeserv
- Kennedy
- Lexidata
- Microcomputer Systems Corp
- Millenium Systems
- Priam
- Raytheon

- Storage Technology
- Systems Industries
- TRW
- Western Peripherals
- Xynetics

APPENDIX C: USERS INTERVIEWED

APPENDIX C: USERS INTERVIEWED

- Align Rite
- Allen Organ
- Amdahl Corporation
- W.H. Brady Co.
- Combustion Engineering
- Cray Research
- Donaldson Corporation
- Floating Point Systems
- Harris Semiconductors
- Honeywell, Inc.
- Hughes Aircraft
- Intel Corporation

- Micro-Fab Systems Corporation
- Motorola, Inc.
- Sperry Univac
- Telephonics Corporation
- United Technologies Corporation
- Vapor Corporation

APPENDIX D: COMPETITOR ON-SITE INTERVIEW GUIDE

COMPETITOR ON-SITE INTERVIEW GUIDE

I. GENERAL

1. WHICH APPLICATIONS ARE ADDRESSED BY YOUR PRODUCTS?

ELECTRONICS _____
MECHANICAL _____
CIVIL ENGINEERING _____
MAPPING _____
OTHER _____
_____ _____
_____ _____

2. WHICH INDUSTRY SECTORS ARE SERVED BY YOUR COMPANY?

ELECTRONICS _____
AEROSPACE _____
AUTOMOTIVE _____
COMMUNICATIONS _____
GOVERNMENT _____
UTILITIES _____
PROCESS MANUFACTURING _____
CONSTRUCTION _____
OTHER _____
_____ _____
_____ _____
_____ _____

3. IN WHICH SECTORS DO YOU ANTICIPATE THE MOST GROWTH FOR CAD/CAM?

_____ _____ _____

4. OVER THE NEXT FIVE YEARS, DO YOU EXPECT COMPOUND GROWTH RATES OF:

	CAD/CAM	YOUR CO.
10%-25%	_____	_____
20%-50%	_____	_____
OVER 50%	_____	_____

5. DO YOU EXPECT PRESENT TURNKEY VENDORS, AS A GROUP, TO BE ABLE TO HOLD THEIR CURRENT MARKET SHARE POSITIONS OVER THE NEXT FIVE YEARS? YES_____ NO_____

COMMENTS:_____

_____

_____

6. FEDERAL GRANTS ARE BEING SUPPLIED TO MAJOR UNIVERSITIES LIKE STANFORD AND M.I.T. TO DEVELOP SOFTWARE FOR COMPUTER AIDED DESIGN, ESPECIALLY IN VLSI. WITH SUCH SOFTWARE GOING INTO THE PUBLIC DOMAIN OVER THE NEXT FEW YEARS, DO YOU VISUALIZE A MAJOR ADJUSTMENT BY YOUR COMPANY AND/OR YOUR COMPETITION?

COMMENTS:_____

_____

_____

7. PLEASE COMMENT ON THE SOCIOLOGICAL IMPLICATIONS OF CAD/CAM IN THE NEAR FUTURE.

PERSONNEL_____

_____

LABOR UNIONS_____

_____

II. TEST 1985 SCENARIO, F.E.

1. F.E. REPORTING STRUCTURE:

1980_____

1983_____

1985_____

2. Is or will F.E. be structured as a profit center?

1980 _____

1983 _____

1985 _____

3. PLEASE RATE THE FOLLOWING SOURCES OF RECRUITS. (scale 1-5)

	1980	1983	1985
TRADE SCHOOLS	____	____	____
OTHER COMPANIES	____	____	____
ARMED FORCES	____	____	____
COLLEGES (2 years)	____	____	____
COLLEGES (4 years)	____	____	____
NO TRAINING	____	____	____
OTHER_____	____	____	____
_____	____	____	____

4. DO YOU SEE AN INCREASING REQUIREMENT FOR F.E. MANAGEMENT TO SELL MAINTENANCE SERVICES VIA A COST/BENEFIT ANALYSIS?

1980 _____

1983 _____

1985 _____

5. DO YOU SENSE A CHANGE IN USER SENSITIVITY TO MAINTENANCE PRICING? YES_____ NO_____

COMMENTS:_____

_____

6. DO YOU EXPECT USERS TO BE PERFORMING MORE ROUTINE SITE MAINTENANCE IN THE NEAR FUTURE?

1980 _____%

1983 _____%

1985 _____%

COMMENTS_____

_____

_____

_____

7. THERE IS A GROWING TREND TOWARD REDEPLOYMENT AND STRATIFICATION OF FIELD ENGINEERING TALENTS WHEREBY THE FIRST LINE OF DEFENSE IS QUALIFIED TO SWAP MODULES, READ LIGHTS ON PANELS, FOLLOW INSTRUCTIONS FROM REMOTE SUPPORT CENTERS, ETC. DO YOU SEE YOUR COMPANY RUNNING WITH OR COUNTER TO THE TREND?

1980 _____

1983 _____

1985 _____

8. DOES YOUR MAINTENANCE PHILOSOPHY OVER THE NEXT FIVE YEARS ANTICIPATE MORE INTERNALLY DESIGNED TESTS AND EXERCISERS BROUGHT TO PANELS AND/OR COMMON INTERFACE TEST PLUGS?

1980 _____

1983 _____

1985 _____

9. DO YOU CURRENTLY HAVE REMOTE DIAGNOSTIC CAPABILITIES?

YES ____ NO ____

a) IF YES, HOW IMPLEMENTED?_____

_____

b) IF NO, WHEN AND HOW IMPLEMENTED?_____

_____

c) DOES/WILL REMOTE DIAGNOSTICS INCLUDE DOWNLOADING FOR FOR PERIPHERALS? YES _____ NO _____

10. DO YOU SEE A NEED FOR DIFFERENT TYPES OF PORTABLE TEST EQUIPMENT BY 1985?

a) YES ___ NO ___

DISCUSS:_____

_____

b) WILL SUPPORT LEVEL FIELD ENGINEERS REQUIRE ADDITIONAL SKILLS IN USE OF MORE SOPHISTICATED TEST DEVICES SUCH AS LOGIC ANALYZERS BY 1985? YES ____ NO ____

DISCUSS:_____

_____

11. DO YOU SEE ANY REQUIREMENTS FOR F.E. TO BECOME MORE APPLICATIONS-ORIENTED BY 1985? YES ____ NO ____

COMMENTS:_____

_____

_____

12. HOW DO YOU PERCEIVE THE SUBJECT OF TOTAL SERVICE IN THE TURNKEY CAD/CAM BUSINESS, i.e., HARDWARE MAINTENANCE, SOFTWARE MAINTENANCE, AFTER-MARKET SALES AS SEPARATE FUNCTIONS VERSUS CENTRAL CONTROL?

1980 _____

1983 _____

1985 _____

COMMENTS:_____

_____

13. IS PRICE SENSITIVITY IN MAINTENANCE PRICING BECOMING MORE VISIBLE TO YOUR COMPANY? YES ___ NO ____

COMMENTS:_____

_____

b) WHAT IS YOUR CURRENT RATIO OF ANNUAL MAINTENANCE PRICE TO EQUIPMENT PURCHASE PRICE?

1980 _____%

1983 _____%

1985 _____%

c) IS SOFTWARE MAINTENANCE INCLUDED IN PURCHASE PRICE, FIELD ENGINEERING MAINTENANCE AGREEMENT PRICING, OR SEPARATELY PRICED?

1980_____

1983_____

1985_____

COMMENTS:_____

_____

_____

_____

14. DOES THIRD PARTY MAINTENANCE AVAILABILITY PLAY A SIGNIFICANT ROLE IN YOUR PLANNING?

1980 _____

1983 _____

1985 _____

15. WILL YOU OFFER THIRD PARTY MAINTENANCE TO OTHER VENDORS?

1980 _____

1983 _____

1985 _____

16. DO YOU ANTICIPATE "UNBUNDLING" OF MAINTENANCE SERVICES?

	1980	1983	1985
USER DIAGNOSIS	____	____	____
USER INSTALLATION	____	____	____
USER REPAIRS	____	____	____
REGION REPAIR DEPOTS	____	____	____
SALE/LEASE OF PARTS	____	____	____
P.M.	____	____	____
VARIABLE RESPONSE TIMES	____	____	____
OTHER_____	____	____	____
_____	____	____	____
_____	____	____	____

17. DO YOU EMPLOY AN ESCALATION PROCEDURE FOR EXTENDED USER OUTAGES? YES _____ NO _____

PLEASE DESCRIBE:_____

_____

_____

_____

18. HOW IS YOUR SPARE PARTS INVENTORY DISTRIBUTED?

HQ.	_____%
REGION DEPOT	_____%
BONDED DEPOT	_____%
DISTRICT/BRANCH	_____%
F.E. (PORTABLE)	_____%
ON-SITE	_____%
OTHER_____	_____%
TOTAL	100%

19. HOW LARGE IS YOUR INVESTMENT IN MAINTENANCE SPARES?

$_____

20. 1980 _____%
1983 _____%
1985 _____%

DO YOU EXPECT THE SPARE PARTS INVESTMENT TO CHANGE AS A RATIO OF MAINTENANCE REVENUES?

III. PRODUCTS

1. CAD/CAM IS ESSENTIALLY AN INTERACTIVE GRAPHICS SYSTEM CURRENTLY DOMINATED BY THE "TURNKEY" STAND-ALONE APPROACCH.

   a) DO YOU SEE THE "TURNKEY" APPROACH CONTINUING IN DOMINANCE?

   1983_____

   1985_____

   b) AS AN ALTERNATIVE, DO YOU SEE THE INTEGRATION OF CAD/CAM SOFTWARE INTO CENTRAL DATA PROCESSING WITH LESS EXPENSIVE INTELLIGENT WORK STATIONS?

   1983 _____

   1985 _____

2. DO YOU VISUALIZE PROCESS CONTROL AS A LOGICAL EXTENSION OF CAD/CAM IN A FULLY INTEGRATED MANUFACTURING OR INDUSTRIAL PROCESSING ENVIRONMENT?

1980 _____

1983 _____

1985 _____

3. WOULD YOU COMMENT ON CAD/CAM PRODUCTS OF THE FUTURE?(1985)

COMMENTS:_____

_____

_____

_____

4. PLEASE DESCRIBE THE ATTRIBUTES REQUIRED OF A <u>SUPERIOR</u> FIELD SERVICE ORGANIZATION IN THE 1985 CAD/CAM ENVIRONMENT.

_____

_____

_____

_____

5. PLEASE DESCRIBE THE ATTRIBUTES REQUIRED OF A <u>SUPERIOR</u> SALES ORGANIZATION IN THE CAD/CAM ENVIRONMENT OF THE '80s.

_____

_____

_____

_____

_____

APPENDIX E: QUESTIONNAIRES

CATALOG NO. YCCD[ ][ ]

VENDOR QUESTIONNAIRE

1. Do you maintain end user systems:

   a) Yes

   b) No

2. If "Yes," what are the greatest problem(s):

   a) Now: _____

   _____

   _____

   _____

   b) 1985: _____

   _____

   _____

   _____

3. If "No," do you plan to do so:

   a) ☐ Yes

   b) ☐ No

   c) When? _____

   _____

4. Will the number of field engineers required increase:

			Percent Increase
a) In 1980?	☐ Yes	☐ No	_____
b) In 1983?	☐ Yes	☐ No	_____
c) In 1985?	☐ Yes	☐ No	_____

d) Please comment on the causes of these changes:

_____

_____

_____

_____

5. How many field engineering locations do you presently have? _____

a) Has this changed during the last year?

☐ Yes ☐ No

b) 1983 estimate: _____

c) 1985 estimate: _____

OT3

6. In supporting installations, rate the following factors as you perceive their importance to the user (5 = most important, 1 = unimportant); both end user and OEM.

FACTOR	1980		1985	
	E.V.	O.E.M.	E.V.	O.E.M.
a) Manpower availability				
b) Remote diagnostics				
c) Reliability of remote diagnostics				
d) Need for isolating failed components				
e) System support center				
f) Other				
g) Other				

OT3

7. Do you provide a system support center as part of your field service support?

☐ Yes ☐ No

a) If "Yes," when did you begin offering this capability? _____

1) What were the primary reasons for implementing this?

_____

_____

_____

2) Is this system support center for: ☐ Hardware ☐ Software ☐ Both

OT3

8. If you do not currently have a system support center, do you have any plans to implement one?

☐ Yes ☐ No

a) If "Yes," when will such a capability be available to your customers?

_____

OT3

9. Do you provide a remote diagnostic capability as part of your field service support?

☐ Yes ☐ No

a) If "Yes," when did you begin offering this capability? _____

1) What were the primary reasons for implementing it?

_____

_____

_____

2) Is this remote diagnostic capability for:

- ☐ Hardware
- ☐ Software
- ☐ Both

3) How has this remote diagnostic capability affected your maintenance costs?

- ☐ Increased _____ %
- ☐ Decreased _____ %
- ☐ Remain Same

4) What has been your customers reaction to this remote diagnostic capability?

_____

_____

_____

_____

b) If you do not currently have a remote diagnostic capability, do you have any plans to implement one?

☐ Yes ☐ No

1) If "Yes," when will such a capability be available to your customers?

_____

2) If "No," why not?

_____

_____

_____

_____

_____

O
3

10. List the test equipment suppliers and their products of value to you.

Please comment upon their value and capability in 1980 and as anticipated in 1985 (rate: 5 = critical, 1 = little interest). Indicate time of availability.

Vendor	Equipment	Comment	Availability		Rating	
			1980	1985	1980	1985

INPU

11. How do you perceive the spares problem for OEM users?

12. What are your plans and suggestions for improvement of the spares problem?

a) Vendor:

b) User:

c) What is the single most important factor for improvement of the spare parts situation? Describe:

12. d) Would you invest in spare parts for your customer?

_____

_____

_____

_____

_____

O
3
T

13. What is the percentage distribution of spares among the following locations?

	1980	1983	1985
a) Headquarters	_____%	_____%	_____%
b) Depots	_____%	_____%	_____%
c) Branch Offices	_____%	_____%	_____%
d) Customer Locations	_____%	_____%	_____%
	100%	100%	100%

O
T
3

14. During the past year, has there been an increase in the number of customers who maintain spares at their location?

☐ Yes ☐ No _____% Increase

Why? _____

_____

_____

_____

INPU

15. Would you consider acting as a third party to maintain other vendor's products?

- ☐ Yes
- ☐ No
- ☐ Currently Do So

16. Have you offered your customers any of the following to increase their participation in maintenance? Were they successful?

		Offered		Successful	
a)	Better Documentation	Y	N	Y	N
b)	Price Reduction	Y	N	Y	N
c)	Faster Response Time	Y	N	Y	N
d)	Promised Higher Up Time	Y	N	Y	N
e)	Remote Diagnostics	Y	N	Y	N
f)	Easier to Run Diagnostic Routines	Y	N	Y	N
g)	Specialized Instrumentation	Y	N	Y	N
h)	Improved Diagnostic Displays	Y	N	Y	N
i)	Other _____	Y	N	Y	N

_____

_____

_____

_____

_____

O
3

19. During the next three years (1983) will you be providing your customers with:

- ☐ More Documentation
- ☐ Less Documentation
- ☐ Same as Present

a) Why will these changes be made?

_____

_____

_____

_____

_____

O

20. Is test capability incorporated into your equipment? (Exerciser or micro-processor)

a) 1980: _____

Comments: _____

_____

_____

_____

_____

b) 1985: _____

Comments: _____

_____

_____

_____

_____

INP

21. Do you design for unit, board or component replacement:

a) 1980: _____

b) 1983: _____

c) 1985: _____

d) Comment: _____

_____

_____

_____

_____

22. What percentage of total field engineering man-hours was spent in installing engineering change notices (ECN) during 1979?

_____%

Comments concerning present and future:

_____

_____

_____

_____

_____

23. How much do you rely on users for product design:

a) Marketplace (user) driven _____%

b) R&D driven _____%

c) Sales organization driven _____%

100%

O
T
3

24. a) How do you determine what your users want?

b) How do you evaluate and incorporate this in your plans?

O
3

25. Do you intend to become more proficient in debugging application software?

a) 1983: ☐ Yes ☐ No

Comment: _____

b) 1985: ☐ Yes ☐ No

Comment: _____

INPU

25. c) How? _____

_____

_____

_____

_____

26. Describe key issues, type of customer, and driving forces in:

a) 1983:

1) Issues: _____

_____

_____

2) Customers: _____

_____

_____

3) Driving Forces: _____

_____

_____

b) 1985:

1) Issues: _____

_____

_____

2) Customers: _____

_____

_____

3) Driving Forces: _____

_____

_____

OT3

27. Where do you see your greatest business opportunities:

a) 1983:

b) 1985:

OT3

28. What changes would cause the greatest improvement in the maintenance you provide to your users?

CATALOG NO. YCCD[ ][ ]

FIELD SERVICE REQUIREMENTS
FOR CAD/CAM SYSTEMS IN THE MID-1980s*

*The primary objective of this study is to determine the user reaction to a proposed scenario of field engineering requirements for the mid 1980s.

1. Describe the type and number of CAD systems you are presently using.

Model	Quantity	Number of Workstations
_____	_____	_____
_____	_____	_____
_____	_____	_____

2. What applications are performed?

☐ CAD

☐ CAM

☐ CAD/CAM

Describe: _____

_____

_____

_____

3. Is your present system meeting the requirements of your application?

a. In 1980 _____

_____

_____

b. Will it in 1983 _____

_____

_____

c. Will it in 1985 _____

_____

_____

4. How many shifts per day is your system in operation?

a. 1980 _____

Will the workload change in:

b. 1983 _____

c. 1985 _____

5. How would you rate the quality of field maintenance you are presently receiving? (1 = poor, 5 = excellent)

a. Hardware _____

b. Software _____

c. Both

6. Are you presently on a service contract?

☐ Yes ☐ No

a. If "yes," do you plan to renew the contract?

☐ Yes ☐ No

7. Do you plan to purchase a service contract for future CAD/CAM systems?

☐ Yes ☐ No

a. If "no," why not? _____

_____

_____

b. If "yes," will the decision be made on the basis of a cost benefit analysis?

☐ Yes ☐ No

1) If Yes," will the method used be:

a) Present value

☐ Yes ☐ No

b) Payback method

☐ Yes ☐ No

c) Other (describe): _____

_____

_____

_____

8. How much more over and above the present cost of a full service contract would you be willing to pay for 24 hour, 7 day coverage?

_____ %

9. a. What is your attitude towards investing in spare parts inventories?

_____

_____

_____

_____

b. How much would you be willing to invest in spare parts (expressed as a percentage of system cost)? _____ %

10. Please indicate the minimum acceptable requirements, and the actual levels of service received for the following measures:

	Percentage Uptime Percent	MTBF (hours)	MTTRs (hours)		MTTRp (hours)
			Comm.	Arrive	
1980 Required					
Actual					
1983					
1985					

11. a. What percent of the service calls you receive are repeat calls?

_____ %

b. What percent of your service calls result in your having to wait for parts to arrive?

_____ %

c. What percent of your calls are "no trouble found" repeat calls?

_____ %

12. How do you think the FE of 1985 will differ from the FE of today?

13. a. Do you see service as being organizationally separate from sales or as an extension of the sales organization?

b. Do you see this relationship changing within the next five years?

14. The following are indicated trends within the field service function. Indicate your evaluation of the probability of their becoming "standard practice" by 1985, and how acceptable each item would be to you. (1 = highly unprobable, 5 = highly probable) (0 = neutral, +5 = highly acceptable, -5 = highly unacceptable)

		Probability	Acceptance
a.	Routine maintenance performed by user	_____	_____
b.	Board/unit replacement by user	_____	_____
c.	Remote diagnostics without on-site FE	_____	_____
d.	FE more applications oriented	_____	_____
e.	Unbundled service contracts	_____	_____
f.	User lease/purchase of spares	_____	_____
g.	Organizational separation of sales and service	_____	_____
h.	Service cost above 15%	_____	_____
i.	Extra charges for sites beyond 75 mile radius of FE location	_____	_____
j.	System support center	_____	_____

15. a. Do you see a trend within your organization towards centralization of all EDP functions under the MIS Director or EDP Manager, or do you see the CAD/CAM system remaining as a separate function between now and 1985?

_____

_____

_____

_____

b. If your organization continues to purchase CAD/CAM systems at your present rate of expansion, will there be a point reached where the point of purchase responsibility will shift from the user to the EDP or MIS Manager?

☐ Yes ☐ No

Comments: _____

_____

_____

_____

16. a. Do you feel there should be a separate or combined source for maintenance activity in terms of hardware and software?

_____

_____

_____

b. If combined, should the person in charge of that function have background in discrete sales, sales experience with after-market responsibilities or service management?

_____

_____

_____

_____

17. It is generally accepted that changes in the nature of user maintenance requirements as well as the organization of the maintenance function will occur during the next five years.

a. Describe the attributes you would presently consider a superior FE organization to possess:

_____

_____

_____

_____

b. Describe those attributes you feel will be necessary for a field service organization to have to be considered superior in 1983:

c. Describe what you feel will be necessary for a field service organization to be considered superior in 1985:

d. From your experience with your present vendor, do you feel they are going to be able to meet your service needs in the future?

1) In 1980

2) In 1983

3) In 1985

18. a. There are many factors on which a decision to purchase a CAD/CAM system are based. For example, unique applications, equipment reliability, upgradability of the system, flexibility of the system, price, and quality of field service. How much weight do you attach to the quality of field service in this decision process?

b. Would quality of field service be given a greater weight now than it received in the initial purchase decision?

c. As you upgrade your present system to meet your future needs, do you look to Calma to fulfill those needs?

d. Is poor field service a sufficient reason to eliminate a vendor from consideration for future CAD/CAM systems purchases?

19. Do you see process control as a logical extension of the CAM function?

20. What vendors have contacted you in the last six months concerning your future CAD/CAM needs?

21. a. Are present CAD/CAM systems meeting the requirements of VLSI technology?

b. What vendors do you look to to provide the systems capabilities required in the next five years?

22. a. Do you feel the viability of Calma would be adversely affected if a large vendor (IBM or DEC) were to enter the market with a comparable system?

☐ Yes ☐ No

Comments: _____

_____

_____

_____

b. If "yes," at what time in the future do you feel Calma would be able to "hold their own" against such large vendors?

_____

_____

_____

_____